THE UNIVERSITY OF KANSAS
PALEONTOLOGICAL CONTRIBUTIONS

ARTHROPODA

ARTICLE 2

Pages 1-52, Plates 1-8, Figures 1-33

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By Richard H. Benson and George L. Coleman II

University of Kansas Publications

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By RICHARD H. BENSON and GEORGE L. COLEMAN II

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ILLUSTRATIONS

ABSTRACT

Thirty species belonging to 23 genera of ostracodes have been collected and described from 42 localities in the eastern Gulf of Mexico near the western and southern coast of Florida. The samples were obtained from the open shelf in depths ranging from 19 to 239 feet in waters of normal marine to slightly hypersaline salinity. The substrate of the study area consists of angular fine to medium sand-sized calcareous fragments with minor amounts of quartz and heavy minerals.

The species discussed include eight new species, *Cytherella grossmani, Paracypris? sablensis, Bairdia gerda, Haplocytheridea gigantea, Perissocytheridea laevis, Hemicytherura sablensis, Loxoconcha sarasotana,* and *Puriana fissispinata;* one new subspecies, *Aurila conradi* (HOWE & MCGUIRT) *floridana;* one new genus, *Loxocorniculum;* three new combinations, *Loxocorniculum fischeri* (BRADY) [the designated type-species of *Loxocorniculum*], *Loxocorniculum postdorsolatum* (PURI), and *Aurila amygdala* (STEPHENSON); three forms with definite affinities to previously described species, *Pterygocythereis* sp. aff. *P. americana* (ULRICH & BASSLER), *Loxoconcha* sp. aff. *L. australis* BRADY, and *Actinocythereis* sp. aff. *A. exanthemata* (ULRICH & BASSLER); two species with tentative identifications, *Cytherelloidea* sp. cf. *C. sarsi* PURI, and *Bairdia* sp. cf. *B. bradyi* VAN DEN BOLD; and 13 previously described species, *Bairdia victrix* BRADY, *Bairdoppilata triangulata* EDWARDS, *Campylocythere laevissima* (EDWARDS), *Cytheretta sahnii* PURI, *Protocytheretta daniana* (BRADY), *Haplocytheridea proboscidiala* (EDWARDS), *Hulingsina ashermani* (ULRICH & BASSLER), *Cytherura johnsoni* MINCHER, *Paracytheridea tschoppi* VAN DEN BOLD, *Pellucistoma magniventra* EDWARDS, *Puriana rugipunctata* (ULRICH & BASSLER), *Orionina bermudae* (BRADY), and *Echinocythereis garretti* (HOWE & MCGUIRT).

The distribution of Recent ostracode species that are found also in Miocene rocks corroborates prior paleoecological interpretations of the environments in which the Miocene sediments were deposited. Depth of water, a factor indirectly reflecting the amount of light penetration, wave base, and proximity to shore, appears to be the major factor influencing the distribution of Recent ostracode species within the area of investigation.

From a review of the studies of Recent ostracodes found in the Gulf of Mexico and the Caribbean Sea, a biogeographic classification of the faunas is suggested, including a Gulf realm, a Caribbean realm, and a deep-basin realm. New divisions of the ostracode faunas from offshore of the west coast of Florida seem warranted, to include assemblages representative of a back-reef lagoon facies (Florida Bay) and a southern carbonate shallow-shelf facies grading northward near Tampa into a shallow-shelf clastic facies.

INTRODUCTION

The fossil ostracodes of the Paleogene and lower Neogene open-shelf facies of the Gulf Coast and Florida are reasonably well known, but their living descendants inhabiting the shallow open waters of the present Gulf of Mexico are relatively unstudied. This report includes the descriptions and discussions of the carapaces of most of the ostracodes of the eastern Gulf that are of particular interest to the paleontologist and paleoecologist. As ostracodes become better understood their value as indicators of environment for stratigraphic studies increases. Besides their geological usefulness, they are themselves of considerable interest. Very few animals with the long fossil record of the Ostracoda are as diverse, as abundant, and as complex. As they become better known they provide many interesting examples and problems of adaptation and evolution. The descriptions of many faunas will be needed before the biogeographic distribution of living and fossil ostracode assemblages can be determined. The present study attempts to explore some of the possible biogeographic relationships of the Recent ostracode faunas of the Gulf of Mexico and Caribbean Sea, but it is intended primarily as a faunal description with emphasis on the taxonomic relationship of the member forms.

PREVIOUS STUDIES

The present faunal study of the ostracodes of the eastern part of the Gulf of Mexico represents but one in a series of studies (Fig. 1) that have been conducted by various workers along a line from the northwest corner of the Gulf, including a few localities in the Antilles, to Trinidad and the Gulf of Paria in Venezuela. The ostracode faunas of the Florida area (PURI & HULINGS, 1957; PURI, 1960; and the present study) have been relatively well studied. Other reasonably well-known faunas include those from San Antonio Bay (SWAIN, 1955), the Mississippi Delta (CURTIS, 1960), and the waters near Trinidad (KRUIT and KEY, in VAN ANDEL & POSTMA, 1957). The long expanse over the Upper and Lower Antilles has been examined only in the sketchiest manner (BRADY, 1866, 1869, 1880), so that the composition of the ostracode faunas of this region is conjectural.

With the exception of the eight species described almost 100 years ago by BRADY (1869) from the Colon-

Aspinwall segment of the sea floor near Panama, nothing is known of the Recent ostracodes of the large western and southern parts of the American Mediterranean.

The earliest marine ostracodes to be described from the tropical parts of the western hemisphere were by BRADY in 1866, along with many other "new or imperfectly known species of marine Ostracoda" collected from Norway, Turks Island in the Bahamas, the West Indies(?), Australia, and other scattered areas of the world, including Brazil and the Mediterranean. The illustrations are surprisingly good for an early work, showing some hinges and a few muscle-scar patterns, but of the eight species described from this work none could be positively identified from the Florida waters.

In 1869 BRADY again described several new ostracode species from the western hemisphere, this time from New Providence in the Bahamas, the island of Haiti, and in the Caribbean off the Colon-Aspinwall coast of Panama. Eight species were included in FOLIN & PERIER's "Les Fonds de la Mer." This publication, unfortunately, is almost impossible to obtain today, and the illustrations and descriptions of many of these species have to be studied in BRADY's subsequent works.

The Challenger Expedition [1873-76] obtained samples from the waters off Bermuda and east of Puerto Rico near Culebra Island. Thirteen species were later described by BRADY (1880) from these two localities; however, almost a dozen species from other areas included in this report have been identified from the American Mediterranean in subsequent studies.

More than 70 years elapsed before any concerted effort was directed toward more than just the description of isolated species. In his study of the Tertiary and Cretaceous ostracodes of the Caribbean, VAN DEN BOLD (1946) included notations of the presence of several fossil forms from the Recent sediments off Gibara, Cuba. In 1954 two comparatively comprehensive studies were published, including faunas from opposite ends of the American Mediterranean; one by TRESSLER, which is a summary of a yet-unpublished study by ROTHWELL of the ostracodes of the northwestern Gulf of Mexico; the other by KRUIT and KEY, who contributed contiguous sections on the distribution and systematics of the ostracode fauna of the Gulf of Paria as parts of a symposium brought together by VAN ANDEL & POSTMA (1954) on the Recent sediments and microfauna of this area. Of the 47 species included by TRESSLER (1954) that might have been found in the eastern Gulf of Mexico, only three, possibly five, have been identified in the present study.

In 1955, SWAIN described the distribution and ecology of the nearshore and brackish-water ostracodes of a section of the barrier lagoon areas along the Texas coast, with special attention to the fauna of San Antonio Bay. Shortly afterward PURI & HULINGS (1957) published the results of a study of the ostracode fauna around Panama City and Alligator Harbor in northwestern Florida and compared these forms with those identified in half a dozen samples collected from the peripheries of Tampa and Florida bays. PURI (1960) later published separately the descriptions of these species in a paper entitled "Recent Ostracoda from the Coast of Florida." None of the samples were collected from the 360-mile-long coastal area between Panama City and Florida Bay included in the present study.

KORNICKER (1958 and 1959) published a comprehensive study of the myodocopid ostracodes of Bimini Island in the Bahamas. The fauna described did not include podocopid or platycopid species.

The ostracode biofacies of the Recent sediments from the east Mississippi Delta area were studied by CURTIS (1960). The species were identified and their distributions compared with "environmental energy levels" throughout the shallower marine and brackish areas adjacent to the east flank of the delta. The ostracodes were illustrated but not described or discussed.

The present study is, consequently, the first to be concerned with an open shelf, neritic ostracode fauna with efforts directed toward its taxonomic and biogeographic relationships. The comparison of the eastern Gulf fauna with those previously described has met with only limited success, as techniques of illustration and descriptions as well as the systematics of ostracodes have changed greatly in later years, making it very difficult to equate the results of the many studies originally designed for somewhat different purposes. It is noteworthy that study of the ecology of the ostracodes has recently been of more interest than investigation of their taxonomic relationships and evolution; this reflects an increased need to recognize environmental indicators for older sediments. Systematic studies, although very much needed, have become less popular.

FIELD AND LABORATORY METHODS

Samples used in this study were obtained during August and December, 1956, and March, 1957, on

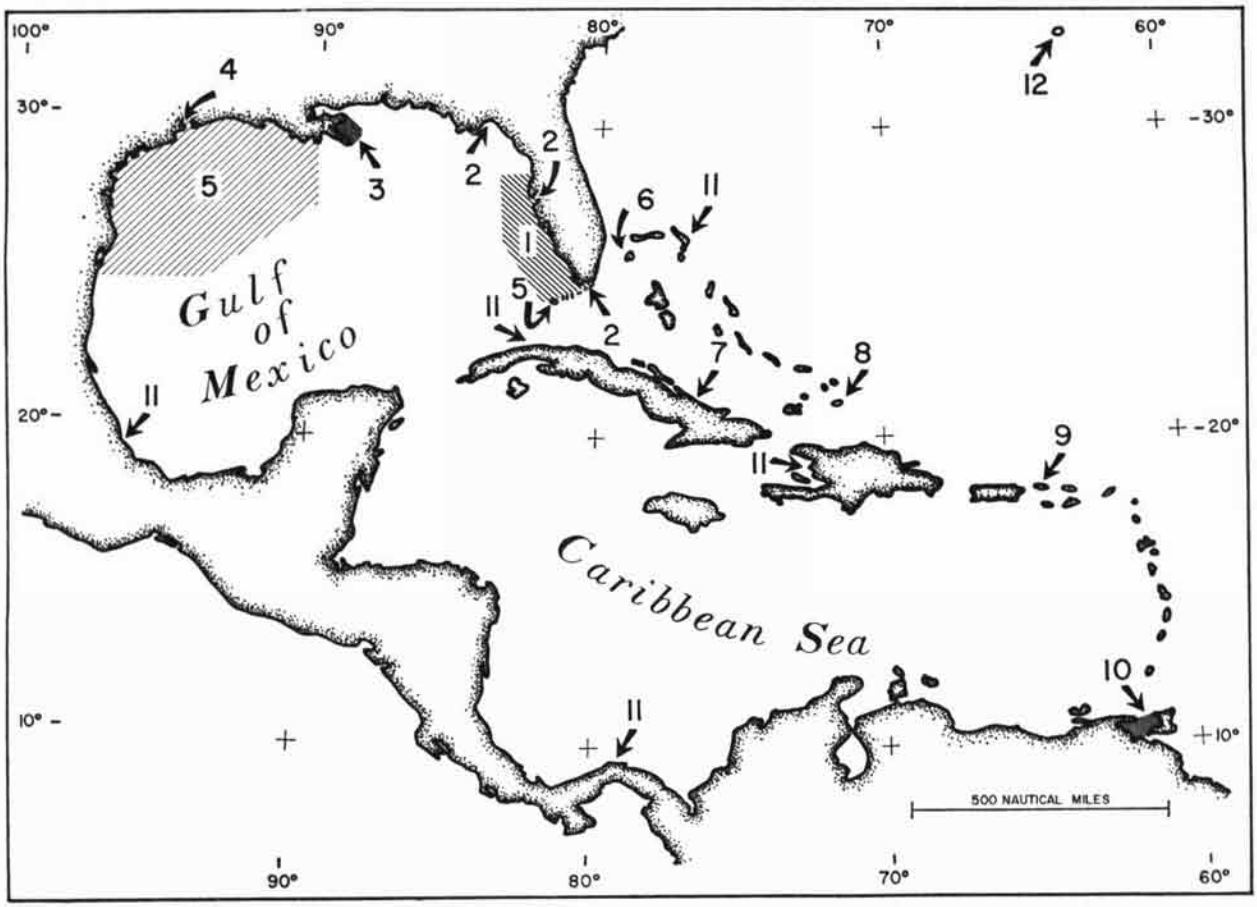


FIG. 1. Locations of Recent marine and estuarine ostracode studies within the American Mediterranean region prior to 1963.

1. The present study.—*2.* Alligator Harbor, Tampa Bay, and Florida Bay (PURI & HULINGS, 1957, and PURI, 1960). —*3.* East Mississippi Delta area (CURTIS, 1960).—*4.* San Antonio Bay (SWAIN, 1955).—*5.* Northwest Gulf of Mexico (TRESSLER, 1954).—*6.* Bimini Island (KORNICKER, 1958).—*7.* Gibara, Cuba (VAN DEN BOLD, 1946).—*8.* Turks Island (BRADY, 1866).—*9.* Culebra Island (BRADY, 1880). —*10.* Gula of Paria (KRUIT and KEY, *in* VAN ANDEL & POSTMA, 1954).—*11.* Colon-Aspinwall, Panama, and Port au Prince, Haiti (BRADY, 1869).—*12.* Bermuda (BRADY, 1880).

three cruises of the oceanographic Research Vessel *Gerda,* owned and operated by the University of Miami, Florida, Marine Laboratory. The primary purpose of the cruises was to gather data which might help in determining the causes of the "Red Tide," a periodic phenomenon in the Gulf of Mexico that results in mass mortality of many kinds of marine organisms. Three geologists from the University of Kansas participated in each of the three cruises, dredging bottom samples and assisting the Marine Laboratory personnel in gathering oceanographic data.

Large bottom samples were obtained by means of an orange-peel dredge. Smaller samples limited to the upper 2 inches were taken with a bottom sediment corer containing a plastic core liner 2 inches in diameter. The samples examined from the cores included the surface sediment containing living ostracodes. All samples were treated with a buffered solution of formalin to preserve soft parts of ostracodes and stored in glass jars until they could be processed.

In the laboratory, the samples were washed through 18-, 35-, and 60-mesh sieves and treated with Rose Bengal, a protoplasm-selective stain that is commonly used to permit the identification of ostracodes and foraminifers that were living at the time of collection. The samples were then air-dried.

The material from the 35- and 60-mesh screens was examined, and the ostracodes were removed and mounted for further study. The specimens collected from each station were examined, identified, and com-

pared with those from other localities to note the amount of intraspecific variation and to determine the distribution of species. The Rose Bengal solution did not yield the desired results, in that some samples were affected much more than others, which were scarcely stained at all. As a result, no accurate determination of the number of living specimens could be made. The only notation possible was a count of specimens that still had both valves intact after sieving and those possessing recognizable remains of soft parts.

Drawings of the ostracodes were made with the aid of a camera lucida. Photographs were made with a 35-mm camera using a 32-mm objective.

ACKNOWLEDGMENTS

The collection of samples for this study was made possible by the University of Miami Marine Laboratory, which permitted dredging operations during three cruises of its oceanographic Research Vessel *Gerda*. From information gathered simultaneously with the dredging of samples, the Marine Laboratory has graciously furnished oceanographic data from each collecting locality.

We are happy to acknowledge the help of HOWARD WHITNEY, formerly of the Marine Laboratory, and SELWYN J. BEIN, Coordinator of Red Tide Studies of the Marine Laboratory, who aided in collecting samples. Others who assisted in the collection of samples include CHARLES W. PITRAT, STUART GROSSMAN, LLOYD FOSTER, EDWIN D. GUTENTAG, and FREDERICK R. SIEGEL. ROSALIE F. MADDOCKS assisted with the photography of specimens. ROGER L. KAESLER examined some of CORYELL & FIELD's types at the American Museum to assist in determining the nature of the type-species of *Puriana*. He also assisted with one of the drawings; the rest were made by the senior author.

DESCRIPTION OF STUDY AREA AND ENVIRONMENTAL FACTORS

The area sampled during the present study is found on the continental shelf in the eastern Gulf of Mexico off the western and southern coast of Florida, from near Key West to northwest of Tampa (between latitudes 24° 39.9′ and 28° 56.6′N; Fig. 2). Samples were collected as close as 200 yards and as far as 90 miles from shore, but most localities were within 40 miles of shore. The maximum depth of water from which a sample was collected was 239 feet; the minimum was 19 feet. The area is affected by the eastern section of a large, clockwise current gyral that dominates the circulation of the Gulf of Mexico.

More detailed information is presented in the following sections on environmental factors affecting the eastern Gulf of Mexico. The University of Miami Marine Laboratory furnished data confirming the location, depth of water, and bottom salinity at the stations from which samples were taken (Table 1; Fig. 2). Although bathythermograph readings were taken at each locality, no temperature data have yet become available from the Laboratory. In its studies of the Gulf of Mexico, the Marine Laboratory conducted several cruises each year for several years in an attempt to chart the seasonal variation of currents, collecting data on currents at the time of observation, surface and bottom salinity, bottom phosphate and nitrate content of the water, and temperature of the water from the surface to the bottom. When such detailed information is compiled and becomes available, it should prove invaluable in ecological studies of all forms of marine life.

TEMPERATURE

Surface temperatures are fairly constant throughout the Gulf of Mexico during the summer, averaging about 84° in August (LEIPPER, 1957). Average surface temperatures for February in the area of investigation range from about 70° in the southern to about 65° in the northern part. Bottom temperatures are usually somewhat lower, although in some places the water is too shallow or currents too strong for temperature stratification to develop. Differences in temperatures within the eastern Gulf have no known direct effect on the selection of particular ostracode species other than the development of the semitropical fauna as a whole.

SALINITY

The salinity of the Gulf waters varied from 34.49 to 39.92‰ at the localities sampled. The highest salinity recorded was found at the station near Florida Bay, where the salinity is known to be as great as 50‰ in the summer. Throughout the eastern Gulf of Mexico the salinity of the shallow waters is high during the summer, as evaporation exceeds precipitation and lack of wind greatly reduces mixing of the water. The highest salinity recording, excluding the area affected by Florida Bay, was 37.84‰. Three samples were collected from approximately the same locations from which samples had been gathered on a previous cruise,

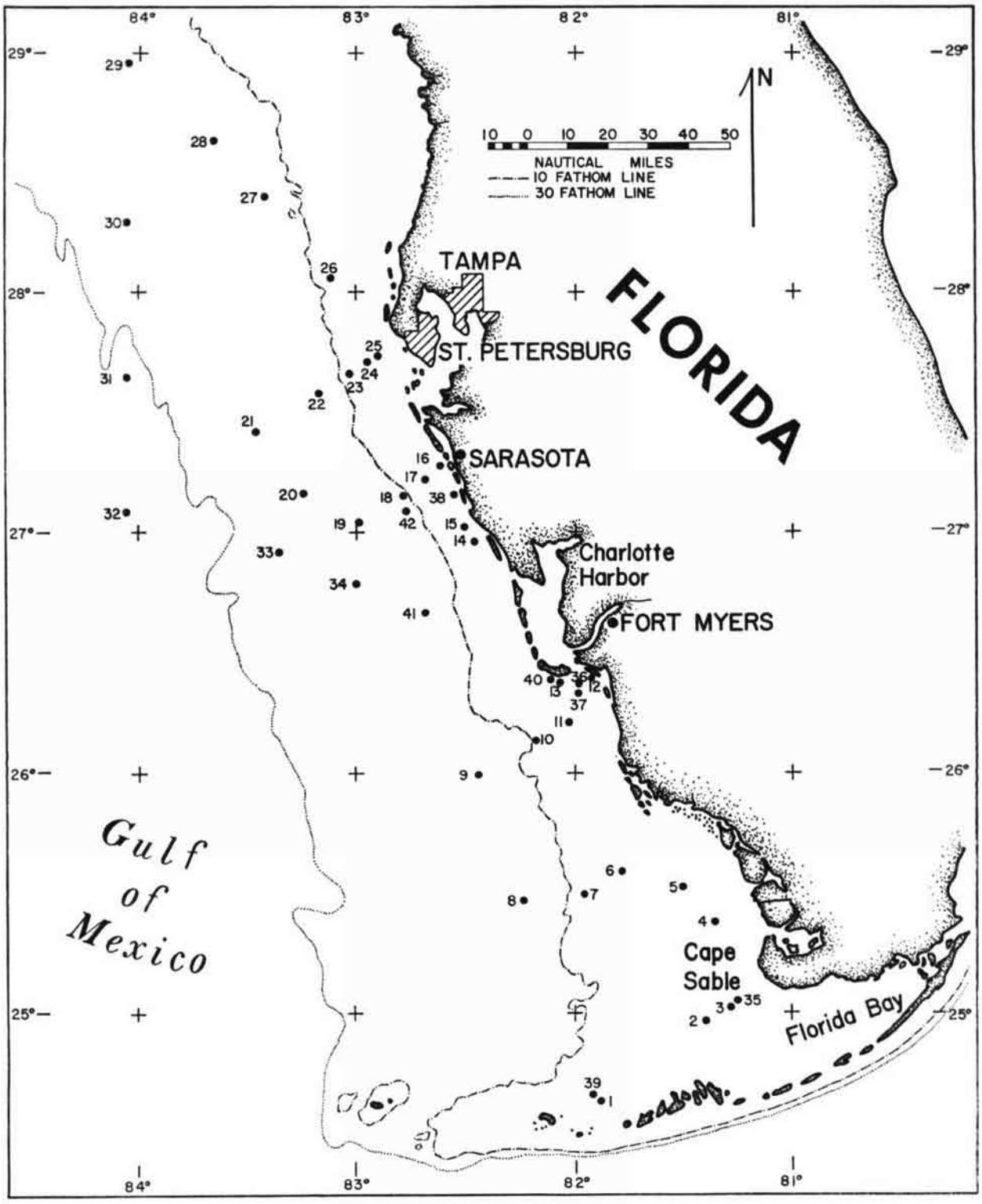


FIG. 2. Ostracode sample collecting stations in the eastern Gulf of Mexico.

and in each instance the salinity during the August cruise was higher than that recorded during the December or March cruise. The salinity near the mouths of rivers flowing into the Gulf of Mexico may be

slightly reduced by the addition of fresh water, but not sufficiently to influence the waters where samples were obtained.

SEDIMENTS

Because the Florida peninsula is low and with little relief, and is composed to a large extent of carbonate sediments, almost no inorganic clastic material is supplied from it to the eastern Gulf of Mexico. Consequently, the sediments in this area are largely composed of calcareous fragments resulting from break-up of the shells of various marine organisms living in the area. At most collecting stations these fragments were found to be angular and predominantly fine- to medium-sand size.

The sediments contain minor amounts of quartz and dark mineral grains, which are invariably rounded. The rounding of these grains has probably taken place over a long period of abrasion, suggesting a very slow rate of deposition. Calcareous material seems to disintegrate before appreciable rounding can be produced by abrasion. The predominance of calcareous shell material indicates the importance of organic production of bottom sediments. The quartz content of the off-shore sediments generally increases toward the north, but beach deposits of the southern part of the west coast of Florida are composed almost entirely of quartz grains. The source of the quartz is probably reworked Tertiary sediments of northern Florida, or the insoluble particles may have been transported from the Appalachian Mountains during the Pleistocene Epoch, gradually being moved southward along the coast by longshore currents. In deeper water, currents are probably not sufficiently strong to carry the quartz sands so far from source areas to the north. The small amount of quartz present in the shelf sediments may have been swept out from shore by rip currents and river discharge. The possibility of relic sediments from former lower sea-level stands is not excluded but thus far is unproven.

Samples containing large amounts of quartz yielded very few or no ostracodes, with exception of those collected from station 24, west of Tampa Bay at a depth of 34 feet, where quartz constituted about 40 percent of the sediment and ostracodes were abundant. Dark minerals made up no more than about 10 percent of the washed material at any locality and did not appear to be correlatable with the presence or absence of particular ostracodes.

At station 14, about three miles from shore and 15 miles north of Charlotte Harbor, sediments collected from a depth of 34 feet were composed entirely of well-rounded grains with a high proportion of quartz. The material was coarser than that found at most other localities and was devoid of ostracodes. Evidently a strong localized offshore current is present in that area, because at station 15, only 1.5 miles to the north, the sediments were angular and predominantly calcareous, typical of the area in general, and yielded many ostracodes.

PURI & HULINGS (1960) recognized two principal ostracode biofacies along the west coast of Florida with assemblages respectively characteristic of a carbonate province and a clastic province. This differentiation is based on the sampling of the nearshore area near Panama City and Alligator Harbor, in northwestern Florida, and Florida Bay, some 360 miles to the south, at the southern tip of Florida. The assemblage of the carbonate province, as exemplified by the fauna of Florida Bay, contained the characteristic genera *Caudites, Xestoleberis, Bairdia, Loxoconcha, Hemicythere, Bradleya,* and *Haplocytheridea.* The assemblage of the clastic province, north of Ten Thousand Islands (adjacent to Florida Bay), contained the characteristic genera *Campylocythere, Microcythere, Haplocytheridea, Pellucistoma, Bythocypris, Paracytheridea, Pterygocythereis,* and *Cytheretta.*

Our study of the area intermediate between the collecting areas of PURI & HULINGS has found that the carbonate province, if one defines this as the area with protocalcilutites and coralline sand, is generally restricted to Florida Bay, but that carbonate in the form of clastic shell debris continues northward beyond the latitude of Tampa to the northern edge of the study area. The terms *carbonate province* and *clastic province,* as applied to sediments offshore of the west coast of Florida, can be misleading. The division between the dominantly carbonate clastic sediment and quartz clastic sediment occurs along the length of the Florida coast, separating the beach and nearshore areas from deeper water. We did find, in agreement with conclusions of PURI & HULINGS, that the offshore sediments become increasingly clastic northward as the clay content increases. As the Mississippi Delta is approached the carbonate content is replaced by clay and silt.

In the south, the facies within what PURI & HULINGS referred to as a carbonate province are very diverse and complex, as are the local ostracode faunas. The changes in bottom sediments and assemblages are more rapid normal to the shoreline than along it.

We would like to emend the biogeographic-ecologic divisions suggested by PURI & HULINGS to include a

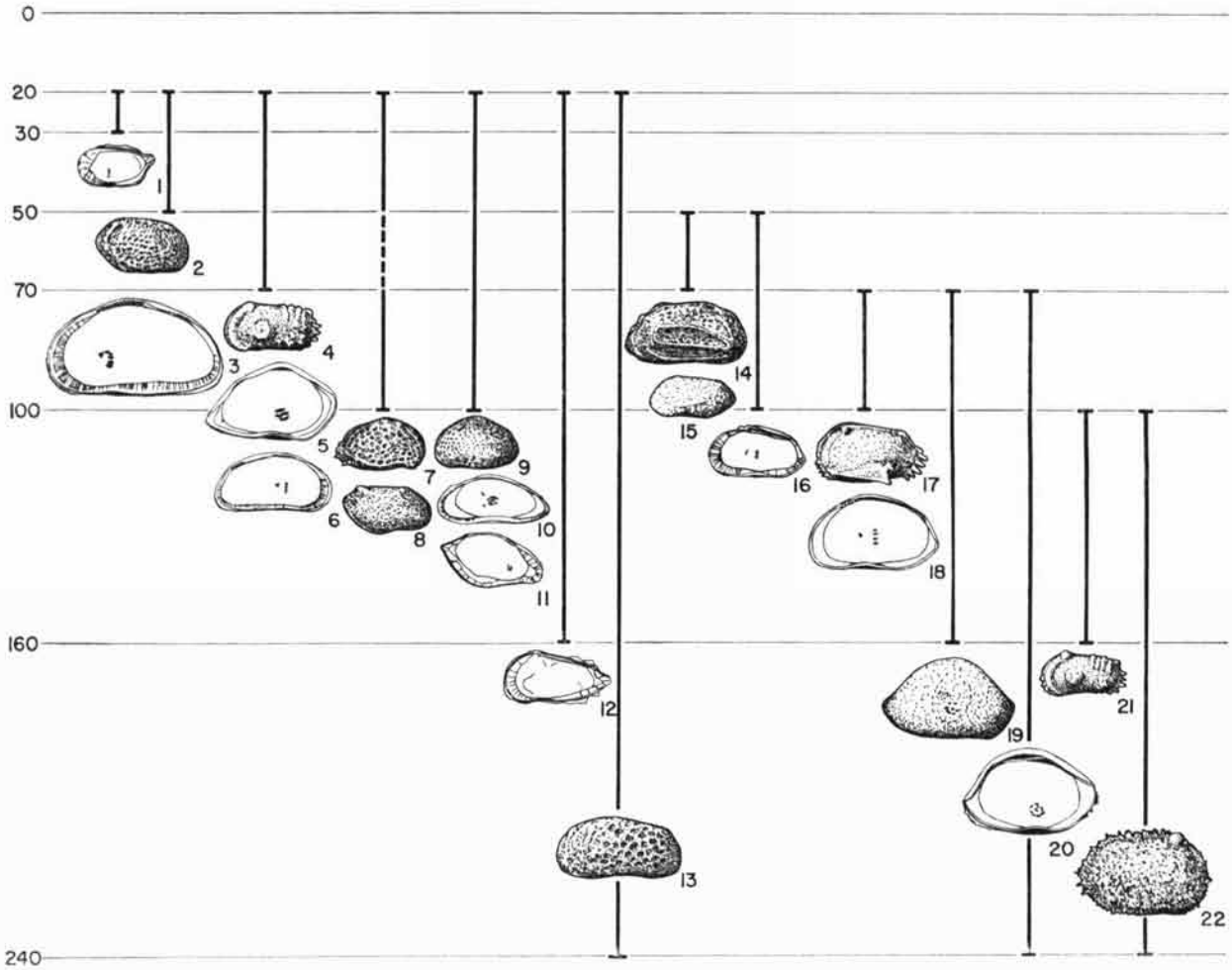


FIG. 3. Distribution of characteristic ostracode species with depth.

1. *Hemicytherura sablensis* BENSON & COLEMAN.
2. *Loxoconcha sarasotana* BENSON & COLEMAN.
3. *Haplocytheridea gigantea* BENSON & COLEMAN.
4. *Puriana rugipunctata* (ULRICH & BASSLER).
5. *Bairdia gerda* BENSON & COLEMAN.
6. *Haplocytheridea proboscidiala* (EDWARDS), 1944.
7. *Aurila conradi* (HOWE & MCGUIRT) *floridana* BENSON & COLEMAN.
8. *Loxocorniculum postdorsolatum* (PURI).
9. *Aurila amygdala* (STEPHENSON).
10. *Paracypris? sablensis* BENSON & COLEMAN.
11. *Pellucistoma magniventra* EDWARDS.
12. *Paracytheridea tschoppi* VAN DEN BOLD.
13. *Hulingsina ashermani* (ULRICH & BASSLER).
14. *Protocytheretta daniana* (BRADY).
15. *Cytheretta? sahni* PURI.
16. *Campylocythere laevissima* (EDWARDS).
17. *Pterygocythereis* sp. aff. *P. americana* (ULRICH & BASSLER).
18. *Perissocytheridea laevis* BENSON & COLEMAN.
19. *Bairdoppilata triangulata* EDWARDS.
20. *Bairdia victrix* BRADY.
21. *Puriana rugipunctata* (ULRICH & BASSLER).
22. *Echinocythereis garretti* (HOWE & MCGUIRT).

back-reef lagoonal facies (Florida Bay) with the generic assemblage listed formerly with the carbonate; a southern, carbonate, shallow-shelf facies with a generic assemblage including *Aurila, Campylocythere, Loxocorniculum, Bairdia,* and *Hemicytherura;* and a northern, clastic, shallow-shelf facies with a generic assemblage including *Pterygocythereis, Paracypris, Haplocytheridea, Hulingsina, Cytherura,* and *Paracytheridea.*

DEPTH OF WATER

Depth of water is inseparable from several factors that were not measured during the course of the field work, such as the degree of light penetration, wave base, and proximity to shore, which can be measured. The aggregate of these factors seems to be the major influence upon the distribution of ostracode species (Fig. 3) within the area of investigation.

Several species were found at all depths sampled, but most were confined within fairly well-defined depth ranges. *Hemicytherura sablensis* was found in very shallow water depths from 20 to 30 feet. *Haplocytheridea gigantea, H. proboscidiala,* and *Loxoconcha sarasotana* were found most abundantly in water less than 35 feet deep. *Bairdia gerda* and *Puriana rugipunctata* are characteristic of depths less than about 75 feet.

Bairdia sp. cf. *B. bradyi, Bairdoppilata triangulata, Protocytheretta daniana, Perissocytheridea laevis, Hulingsina ashermani,* and *Pterygocythereis* sp. aff. *P. americana,* although all present in shallower water, were most abundant at depths exceeding 60 feet. *Loxocorniculum fischeri* was found at a depth of 27 feet, but was much more abundant at depths greater than 75 feet. At no locality was *Echinocythereis garretti* found at a depth less than 70 feet.

Cytherella grossmani, Cytherelloidea sp. cf. *C. sarsi, Paracytheridea tschoppi, Cytherura johnsoni,* and *Aurila conradi floridana* all occurred from the shallowest depth sampled to 150 feet, with *Cytherella grossmani* found to 239 feet.

Even with a limited number of widely separated localities, a distribution pattern of ostracodes based primarily on depth of water is indicated. Locality 18, about 30 miles south-southwest of Tampa Bay, presented an anomalous situation; for there, at a depth of 63 feet, deeper water species were found in association with species that elsewhere were found only at depths of less than 35 feet. Specimens of both types had both valves intact, indicating that living specimens were collected. No explanation of this is possible with the information available.

It should be emphasized that the maximum depths at which ostracode species were found in this study are not necessarily the maximum depths at which they actually live, as only three samples were dredged from depths greater than 100 feet, the deepest being 239 feet. *Orionina bermudae,* for example, was found by BRADY (1880, p. 90) at a depth of 435 fathoms, and *Bairdia victrix* is usually found in very deep water but was also abundant in the shallower parts of the area sampled.

Of the depth zones reported by ROTHWELL (*in* TRESSLER, 1954) from the distribution of the ostracodes in the northwestern Gulf region, only the upper three were sampled in the present study. The differences in species identification between ROTHWELL's opinions and our own are sufficient to prohibit correlation with any confidence; however, several genera of the "barren zone" (10-24 m), such as *Cytherura* and *Loxoconcha,* and of the "marginal shelf zone" (24-38 m), such as *Cytherella* and *Pellucistoma* (called *Paradoxostoma*) are approximately the same. Almost all of the forms identified by ROTHWELL and TRESSLER from shallow depths were new forms or those described by BRADY; most were smooth unornamented forms apparently identified by their lateral outline or by examination of their internal anatomy. Several echinocytherid species (called *Cythereis*) were identified from the "deep sea zone" (1,250+ m, but predominant at 3,000 m). These same forms became more abundant in the deeper areas of the present study.

ROTHWELL suggested that decrease in salinity caused by discharge from Texas rivers may be partly responsible for the presence of certain species in the shallow "barren zone." The salinity of the shallow waters along the Florida coast is not as noticeably affected by fresh-water runoff as the coast along Texas may be. We do not believe that the character or zoning of the open shelf is influenced by any general freshening of the shallower waters.

From their studies of the ostracode faunas off Panama City, Florida, PURI & HULINGS recognized three inner-neritic biofacies that reflect increasing depths (23-47; 47-60; 60-65+ feet). We found *Bairdia, Pellucistoma, Paracytheridea,* and *Aurila* to be common in shallower water than reported by them, but we concur with their findings that *Pterygocythereis* and *Cytheretta* are most abundant offshore in deeper water.

RELATIONSHIP OF RECENT TO FOSSIL ASSEMBLAGES

Of the 30 species described in this paper, at least half have been reported from Miocene and Pliocene sediments of the southeastern United States and Cuba. PURI (1953d) described 12 species from the Alum Bluff and Choctawhatchee Stages of the Florida panhandle, and EDWARDS (1944) described at least six from the Duplin Marl of North Carolina.

In his comprehensive study of the stratigraphy and micropaleontology of the Miocene sediments of Florida PURI (1953d) postulated depth ranges represented by the various strata, based primarily on long-lived species of Foraminifera. Table 1 shows the ostracode species, or their immediate descendants, found in the eastern Gulf of Mexico that have also been found in Miocene sediments of the southeastern United States and the depths of water from which they were taken in Recent

sediments. The maximum depths are limited to the depths sampled for this study and do not necessarily represent the maximum depth of water in which the species actually live. In most cases the conditions found in the eastern Gulf of Mexico agree with those postulated for the Miocene. Ostracode species found in deeper water in the Gulf of Mexico are generally the ones found in facies thought to represent deeper water in the Miocene. The results of our study indicate that the ostracodes could have been used to indicate the environments of the Miocene strata had more been known of their ecology at the time of PURI's study.

TABLE 1. *Ostracode species found in both Miocene rocks and Recent sediments.*

Species	Depth of water (in feet)*	Alum Bluff: Oak Grove	Alum Bluff: Shoal River	Alum Bluff: Chipola	Choctawhatchee: Yoldia	Choctawhatchee: Arca	Choctawhatchee: Ecphora	Choctawhatchee: Cancellaria	Tuplin marl, N.C.
Bairdoppilata triangulata	19-239 (>60)					x	x	x	x
Haplocytheridea proboscidiala	20-95 (<35)					x	x	x	x
Orionina bermudae	27			x		x	x	x	x
Puriana rugipunctata	19-239 (<50)		x		x	x	x	x	x
Echinocythereis garretti	60					x	x	x	
Pterygocythereis americana	19-239 (>75)		x	x		x	x	x	
Aurila amygdala	19-76	x	x	x					
Aurila conradi	19-131					x	x	x	x
Cytheretta sahnii	20-63 (<35)						x	x	
Hulingsina ashermani	32-239 (>60)	x		x		x	x	x	x
Pellucistoma magniventra	24-63 (<35)							x	x
Campylocythere laevissima	19-95 (<25)								x
Cytherura johnsoni	19-131								x

*Figures in parentheses indicate depths at which Recent species are most common.

CHANGES IN POST-MIOCENE OSTRACODES

The closeness of relationship between Miocene ostracodes of the southeastern United States and Antilles and those living in the present seas is indicated by the large number of similar or identical species found in the sediments of both ages. At least four species can be shown to have evolved to form subspecies or closely related species, which probably occupy the same ecologic niche as their ancestors. These include *Cytheretta karlana,* an open shelf species, which has been modified only slightly to form *Protocytheretta daniana. Aurila conradi conradi,* which in the Miocene could possibly be classified as *Hemicythere,* has evolved into at least one subspecies, *A. conradi floridana.* Two species of new genus *Loxocorniculum, L. fischeri* and *L. postdorsolatum* are apparently descendants of the earlier members of *Loxoconcha, L. wilberti* and *L. anderseni.* As the fossil forms are described in more detail, with closer attention paid to surface ornament and hinges, many more examples of Neogene evolution will become evident. Further discussion of these and other possible relationships is given in the section on systematics.

CHANGES IN BIOGEOGRAPHY

It is difficult to generalize about changes in the paleogeographic distribution and evolving character of assemblages without oversimplifying what is usually a complex situation. From a cursory examination of the faunas identified and described by PURI (1953d), MALKIN (1953), ULRICH & BASSLER (1904), HOWE AND OTHERS (1935), VAN DEN BOLD (1946), and MCLEAN (1957), as well as a plotting of the distribution and probable relationship of more than 120 Recent species that have been identified from the Gulf of Mexico and the Caribbean Sea, several changes may be postulated.

The ostracode faunas were more widespread and less differentiated into recognizable realms in the Miocene but nevertheless they retained a northern and southern aspect. Many of the forms presently found in offshore Floridan waters were common in the shallow seas of Maryland and Virginia during the Miocene. These northern Miocene forms seem to be larger on the average than are living Florida animals. The increase in size in individuals of modern faunas is often the result of the slower rate of growth and increased longevity characteristic of cooler waters, suggesting that Miocene waters were not quite as warm as the Gulf of Mexico today. During the Miocene areas including the southern tip of Florida and Cuba were invaded by southern forms, the nearest descendants of which now live in Trinidad and along the lesser Antilles. These faunas, which may have moved northward during the Pleistocene interglacial ages, have left relic populations behind in the unusual environment of Florida Bay and along the southwestern coast of Florida. The southern assemblage seems to contain more species than the northern one, but this apparent difference in numbers may be due to the greater accessibility and more extensive study of the deep-water sediments and their fossil assemblages, which are exposed as the result of the tectonic deformation of the Antilles. The assemblages of the deeper-water facies along the Atlantic coast of the United States are present, but more inaccessible in offshore subsurface strata, and are yet to be described.

As discussed in an earlier section, the ostracode faunas of the eastern Gulf of Mexico can be considered

as belonging to a northern clastic and a southern carbonate shallow-shelf biofacies. The southern biofacies is contiguous with a back-reef, lagoonal biofacies of Florida Bay, where the size of the ostracode population increases and a mixing of Bahaman-Cuban forms with Gulf forms takes place.

The ostracode species of the American Mediterranean can further be said to belong to three faunal realms: **Gulf realm, Caribbean realm,** and **deep-basin realm** that extends over the deeper parts of the entire area. The following species and genera appear to be characteristic of each of these realms.

(a) GULF REALM
Haplocytheridea bassleri
Campylocythere laevissima
Loxoconcha australis
Cytherura johnsoni
Actinocythereis sp. aff. *A. exanthemata*
Aurila conradi floridana
Pterygocythereis sp. aff. *P. americana*
Hulingsina ashermani
Puriana rugipunctata

(b) CARIBBEAN REALM
Triebelina coronata
Loxocorniculum postdorsolatum
Loxocorniculum fischeri
Bairdia bradyi
Orionina bermudae
Paracytheridea tschoppi
Cytherella lata
Cytherella pulchra
Caudites nipeensis
Cativella species

(c) DEEP-BASIN REALM
Pseudocythere caudata
Bairdia victrix
Krithe bartonensis?
Pontocypris species
Cytherella species
Echinocythereis species

SYSTEMATIC DESCRIPTIONS AND DISCUSSIONS

Subclass OSTRACODA Latreille, 1806
Order PODOCOPIDA Sars, 1866
Suborder PLATYCOPINA Sars, 1866
Family CYTHERELLIDAE Sars, 1866
Genus CYTHERELLA Jones, 1849

Cytherella JONES, 1849, p. 28; SARS, 1866, p. 125; MÜLLER, 1894, p. 386; ———, 1912, p. 390; VAN DEN BOLD, 1946, p. 20; KEIJ, 1957, p. 44; BENSON, 1959, p. 39; POKORNÝ, 1958, p. 210; REYMENT, 1961, p. Q382.

Type-species. Cytherina ovata ROEMER, 1840, p. 104, pl. 16, fig. 21.

Diagnosis. Recognized by its thick-shelled, ovate to subquadrate, smooth to punctate, translucent carapace. Hinge adont; right valve overreaching left around entire periphery, receiving left valve in a well-developed accommodation groove. Adductor muscle-scar pattern pinnate, consisting of two rows of small scars located dorsomedially. Sexual dimorphism pronounced, females being wider posteriorly. *Jur.-Rec.*

Ecology. Marine; lagoon to 300 fathoms (HORNIBROOK, 1952).

CYTHERELLA GROSSMANI Benson & Coleman, n.sp.
Pl. 1, Figs. 1-7

Diagnosis. Distinguished by its cuneiform to lenticular carapace as seen in dorsal view; quadrate to subrectangular in lateral view. Posterior part of dorsal margin slightly oblique. A very faint sulcus anterior to the mid-line. *Rec.*

Description. Carapace of adult medium-sized, ovate to subrectangular. Female cuneiform in dorsal view; male lenticular. Height uniform; male widest just posterior to mid-line, female widest near posterior margin. Ovate to oblong or subrectangular in lateral view; dorsal margin of male straight anteriorly, obliquely rounded posteriorly; dorsal margin of female very slightly arched. Ventral margin sinuate, with central concavity; anterior margin broadly rounded; posterior margin of male somewhat more narrowly rounded than anterior; posterior margin of female rounded equally with anterior, but with slight oblique dorsal truncation. Surface of carapace smooth, porcelaneous; normal-pore canals moderately numerous, irregularly arranged. Very faint and shallow sulcus anterior to center. Females larger than males, swollen posteriorly.

Hinge consisting of groove in right valve into which fits ridged edge of left valve; marginal area very narrow, with accommodation groove on right valve. Muscle-scar pattern typical of genus.

Dimensions. Length of adult female specimen 0.72 mm; height 0.41 mm; width 0.28 mm. Length of adult male specimen 0.64 mm; height 0.36 mm; width 0.24 mm.

Material. Specimens examined 112, of which 41 had both valves intact.

Remarks. Immature specimens of this species are smaller, ovate in lateral view, lenticular in dorsal view. *Cytherella grossmani* is similar in lateral view to *C. polita* SARS, found by CURTIS (1960) near the Mississippi Delta, but is more wedge-shaped in dorsal view and possesses a slight sulcus. *C. pulchra* BRADY, found in the Gulf of Paria by KRUIT and KEY, *in* VAN ANDEL & POSTMA, 1954, can be distinguished from *C. grossmani* by its polygonal to subhexagonal shape as seen in dorsal view. *C. grossmani* and *C. pulchra* are approximately the same in size and about half the length of *C. lata* BRADY, 1880, originally described from off Culebra Island, West Indies. *C. grossmani* differs from *C. ovata* (ROEMER), 1840, in possessing a less highly arched dorsum and a narrower marginal area, and from *C. chipolensis* PURI, 1953, in that the posterior part of the dorsal margin of *C. grossmani* is slightly oblique and joins the posterior margin smoothly rather than forming a distinct angle. This species is named for STUART GROSSMAN, who aided in the collection and preparation of samples for this investigation.

Occurrence. Found in the eastern Gulf of Mexico throughout the north-south extent of the area of investigation in the deeper parts of the study area; abundant at localities 3, 20, 30, 32, and 33. Depth range 27 to 239 feet, being most abundant in water deeper than 70 feet; salinity range 34.86 to 39.92‰. Substrate predominantly fine-grained calcareous fragments. Frequently associated with *Cytherelloidea* sp. cf. *C. sarsi.*

Genus CYTHERELLOIDEA Alexander, 1929

Cytherelloidea ALEXANDER, 1929, p. 55; HOWE, 1934, p. 27; VAN DEN BOLD, 1946, p. 20; SEXTON, 1951, p. 808; MUNSEY, 1953, p. 2; BENSON, 1959, p. 39; POKORNÝ, 1958, p. 211.

Cytherella (Cytherelloidea) Alexander, REYMENT, 1961, p. Q383.

Type-species. Cythere williamsoniana JONES, 1849, p. 31, pl. 7, fig. 26a-f.

Diagnosis. Distinguished from other members of the suborder Platycopina by sculpturing on the surface of the carapace, with ridges most prominent. Carapace wedge-shaped, generally compressed in dorsal view. Females usually possess posterior nodes. *Jur.-Rec.*

CYTHERELLOIDEA sp. cf. C. SARSI Puri, 1960

Pl. 1, Figs. 8-10; Fig. 4

Cytherelloidea sarsi PURI, 1960, p. 133, pl. 5, fig. 1, 2.

Remarks. This species was originally described by PURI (1960) from Alligator Harbor and Florida Bay. The forms we found are very similar to the ones described by PURI but larger than the holotype (0.79 mm compared to 0.63 mm). The reticulate surface suggested as diagnostic by PURI was consistently present in all specimens but in varying degrees of development. The distribution of the longitudinal ridges is difficult to observe in many specimens, as they tend to be partly subdued in some and emphasized in others.

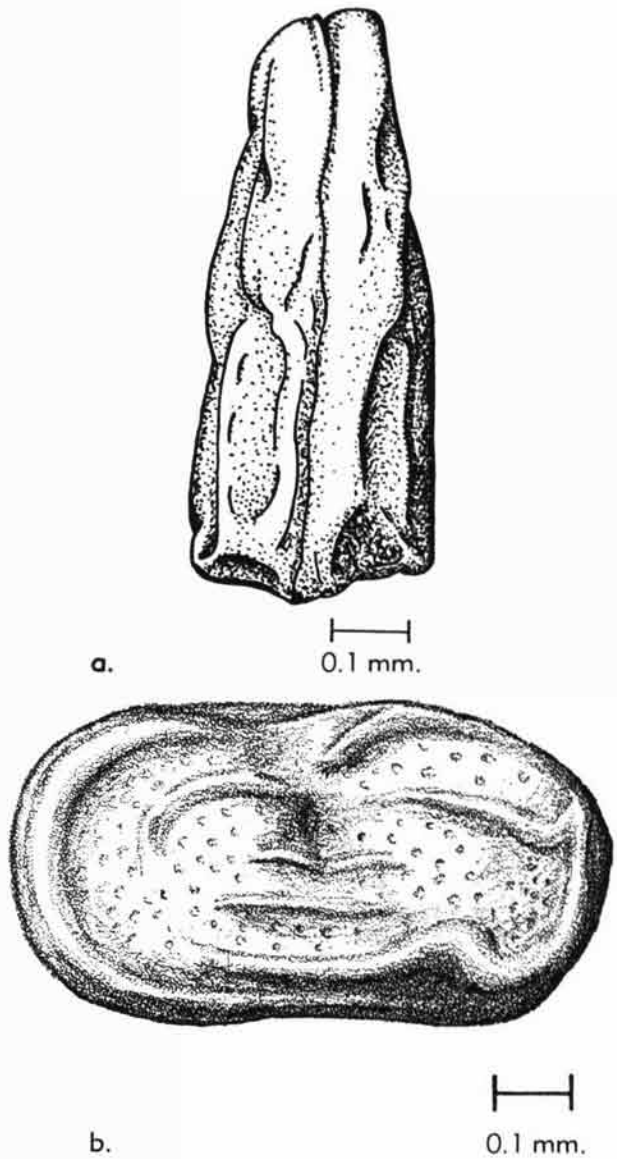


FIG. 4. *Cytherelloidea* sp. cf. *C. sarsi* PURI, 1960.—*a.* Dorsal view of a complete adult female.—*b.* Carbon sketch of an exterior lateral view of the left valve of an adult male.

The identification of this form is qualified because of its lack in exact correspondence with ornamentation and size described by PURI. Further study may demonstrate that this difference is individual variation.

Sexual dimorphism occurs in this species, females being larger than males and swollen posteriorly, as in *Cytherella*. Some variation occurs in development of the surface ridges, the longitudinal ridges failing to intersect the posterior transverse ridge in some specimens. This species is quite similar to *C. castleberryensis* HOWE & LAW, 1936, but it lacks a short ridge near the ventral margin and has a rounded, rather than truncate, posterior margin.

Material. Specimens examined 48, of which 19 had both valves intact.

Occurrence. Reported previously only by PURI (1960, p. 133) from Recent sediments of Alligator Harbor and Florida Bay. Found in the eastern Gulf of Mexico between latitudes 24° 59.0'N and 28° 17.4' N; abundant at locality 3, with complete specimens found also at localities 2, 4, 8, 11, 16, 17, 20, 29, 32. Depth range 27 to 154 feet; salinity range 35.61 to 39.92‰. Substrate predominantly fine-grained calcareous fragments. Commonly associated with *Cytherella grossmani*.

Suborder PODOCOPINA Sars, 1866

Superfamily CYPRIDACEA Baird, 1845

Family PARACYPRIDIDAE Sars, 1923

Genus PARACYPRIS Sars, 1866

Paracypris SARS, 1866, p. 11; BRADY, 1880, p. 31; MÜLLER, 1894, p. 243; ———, 1912, p. 125; SARS, 1923, p. 69; VAN DEN BOLD, 1946, p. 22; KEIJ, 1957, p. 51; BENSON, 1959, p. 40; POKORNÝ, 1958, p. 230; SWAIN, 1961, p. Q245.

Phlyctenophora BRADY, 1880, p. 32; BRADY & NORMAN, 1889, p. 94.

Type-species. Paracypris polita SARS, 1866, p. 12.

Diagnosis. Recognized by its elongate, posteroventrally pointed, smooth, wedge-shaped carapace; left valve overlapping right anterodorsally. Hinge adont. Marginal area moderately broad, with wide vestibules anterior and posterior. Bifurcating radial-pore canals. Muscle-scar pattern consisting of anterior row of three or four scars, with two behind. *?Sil., Jur.-Rec.*

Ecology. Typically marine, both a burrower and mud surface-dweller. Depth range unknown.

Remarks. It is not always possible to decide from examination of the shape of the carapace if a fossil form should be assigned to *Paracypris* SARS or to *Pontocypris* SARS, 1860. TRESSLER (1954) listed several species of *Pontocypris* which were identified by ROTHWELL from the northwestern Gulf of Mexico, but no species of *Paracypris*. POKORNÝ (1958, p. 228) stated that *Pontocypris* has spines on the posteroventer of the right valve, although none of the species listed by TRESSLER and originally figured by BRADY have spinose valves.

PARACYPRIS? SABLENSIS Benson & Coleman, n.sp.

Pl. 1, Figs. 11-13; Fig. 5

Diagnosis. Distinguished by its smoothly and broadly arched dorsal margin, almost straight venter, simple radial pore canals, and lack of a dorsal flange anterior to the hinge of the left valve. *Rec.*

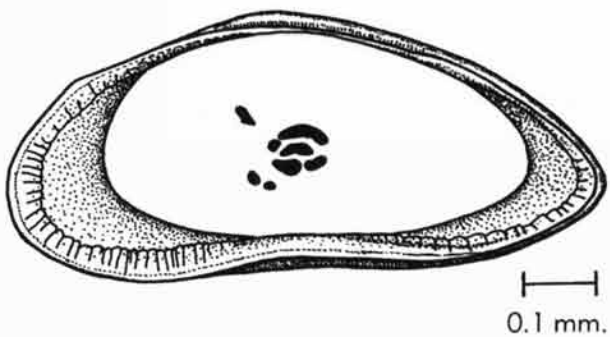


FIG. 5. *Paracypris? sablensis* BENSON & COLEMAN, n. sp. Interior view of the right valve of an adult specimen showing the straight simple radial-pore canals and a typical muscle-scar pattern.

Description. Carapace medium-sized, elongate-subreniform, lenticular in dorsal view, highest anterior to mid-line, widest centrally; dorsal margin broadly and smoothly arched; venter of left valve straight, of right valve slightly concave centrally; anterior margin broadly rounded; posterior margin narrowly rounded ventrally. Surface of carapace smooth, with widely spaced normal-pore canals in dorsal and ventral areas.

Hinge adont, dorsal margin of left valve grooved to receive ridged edge of right valve. Marginal area broad, with wide vestibules anterior and posterior. Muscle-scar pattern consisting of cluster of 3 elongate scars, of which lower 2 may be subdivided, with 2 smaller anteroventral mandibular scars and single anterodorsal antennal scar. Radial-pore canals numerous, simple, usually paired.

Dimensions. Length of adult specimen 0.79 mm; height 0.39 mm; width 0.33 mm.

Material. Specimens examined 212, of which 61 had both valves intact.

Remarks. The generic assignment of this species is questioned because of the nature of the radial-pore

canals, which are simple and straight as compared to the bifurcated or polyfurcated canals usually found in species of the genus *Paracypris*. If carapace shape and polyfurcation of radial-pore canals are to be considered diagnostic for identification of *Paracypris, Aglaiella,* and *Aglaiocypris,* then future workers may want to erect another category to receive a paracyprid with simple and straight radial-pore canals. We have not seen enough material to justify proposal of a new genus at present.

Paracypris polita SARS, 1866, is more elongate, more narrowly rounded posteriorly, and has much wider vestibules than *P.? sablensis*. *P. choctawhatcheensis* PURI, 1953, has a sinuate venter and a prominent projecting flange in front of the hinge of the left valve. The straight to slightly convex venter distinguishes *P.? sablensis* from most other species of *Paracypris*. Named after Cape Sable, southernmost point on the west coast of Florida, near which the holotype was collected.

Occurrence. Found in the eastern Gulf of Mexico throughout the north-south extent of the area of investigation; abundant at localities 3-5, 15-18, 20, 21, and 36 off the coast of Florida near Sarasota. Depth range of specimens living when collected 19 to 63 feet; single valves found to 95 feet. Salinity range 36.23 to 39.92‰. Substrate predominantly medium-sized calcareous fragments. Frequently associated with *Paracytheridea tschoppi, Loxocorniculum postdorsolatum,* and *Aurila conradi floridana.*

Superfamily BAIRDIACEA Sars, 1888
Family BAIRDIIDAE Sars, 1888
Genus BAIRDIA M'Coy, 1844

Bairdia M'COY, 1844, p. 164; BRADY, 1880, p. 47; KELLETT, 1934, p. 120; SCOTT, 1944, p. 162; EDWARDS, 1944, p. 506; SYLVESTER-BRADLEY, 1950, p. 751; BENSON, 1959, p. 42; POKORNÝ, 1958, p. 225; SHAVER, 1961, p. Q202.

Type-species. Bairdia curta M'COY, 1844, p. 164.

Diagnosis. Recognized by its subrhomboidal to subtriangular, smooth or punctate carapace; anterior rounded to angular; posterior often acuminate; dorsum highly arched. Left valve much larger than right, with marked overlap along dorsum and venter. Hinge adont; wide anterior and posterior duplicatures and vestibules. Adductor muscle scars numerous, forming circular or oblong pattern. *Ord.-Rec.*

BAIRDIA VICTRIX Brady, 1869

Pl. 2, Figs. 4-10; Fig. 6

Bairdia victrix BRADY, 1869, p. 152, pl. 18, figs. 17, 18; ———, 1880, p. 56, pl. 10, fig. 5; PURI, 1960, p. 131, pl. 6, fig. 13.
Nesidea victrix (Brady), ROTHWELL, in TRESSLER, 1954, p. 433.

Diagnosis. Distinguished by its large, very finely punctate carapace. Dorsal margin highly arched, posterior produced into slight subventral caudal extension. Fine denticles at antero- and posteroventral corners of left valve; striate frills at same positions on right valve. *Rec.*

Description. Carapace large, robust, tumid, subovoid, lenticular to broadly ovate in dorsal view, highest and widest medially, subovate to subtriangular in lateral view; dorsal margin highly arched centrally, straight to very slightly concave anteriorly and posteriorly; venter slightly arcuate; anterior margin broadly rounded below, forming obtuse angle with dorsum above; posterior margin obliquely rounded below, obliquely truncate above, with very slight subventral caudal process. Surface of carapace very finely punctate; most of carapace translucent, but with mottled areas of opaque shell material. Ornamentation restricted to antero- and posteroventral margins,

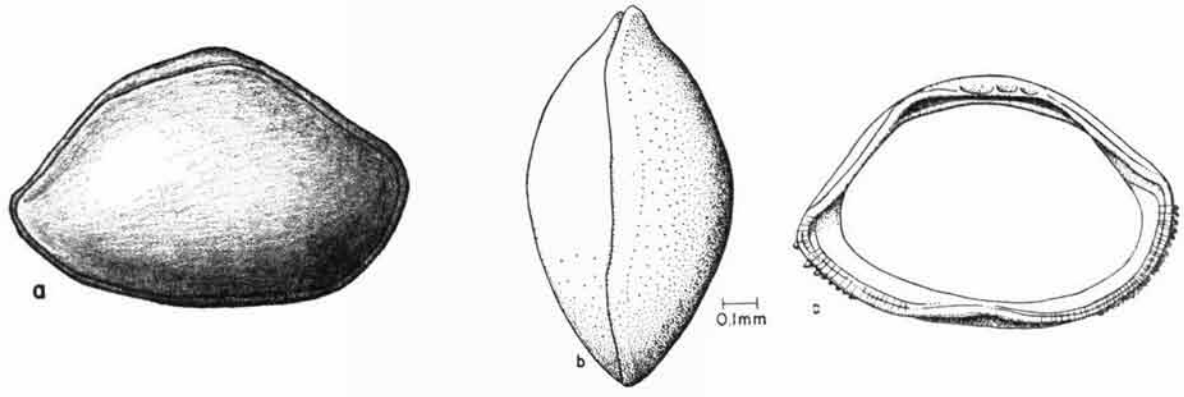


FIG. 6. *Bairdia victrix* BRADY, 1869.—*a*. Carbon sketch of the right side of a whole specimen showing the valve overreach; the left valve over the right.—*b*. Dorsal view of a whole adult specimen.—*c*. Interior view of the left valve of an adult specimen.

with denticles on the left valve and striate frills on right.

Hinge adont and very stout, with bar of right valve fitting into groove on left valve. Marginal area moderately broad, with narrow vestibules developed anteriorly and posteriorly. Selvage strongly developed, particularly mid-ventrally. Adductor muscle-scar pattern consisting of subcircular pattern of 7 slightly elongate scars with either single reniform scar or 2 or 3 smaller circular scars at center of group. Radial-pore canals not seen.

Dimensions. Length of adult specimen 1.10 mm; height 0.74 mm; width 0.47 mm.

Material. Specimens examined 193, of which 16 had both valves intact. Of these, 125 specimens, 7 of them complete, were immature.

Remarks. Specimens resembling those described and illustrated by EDWARDS (1944) as *Bairdia laevicula* were found associated with the above-described forms throughout the entire area of investigation and appear to be immature individuals. They differ from adults in being smaller, more elongate, and in having narrower marginal areas, and less stout hinges. Aside from differences in proportions, however, the features are quite similar.

The adult specimens differ from *B. antillea* VAN DEN BOLD, 1946, in being more highly inflated. The higher specimens, subcircular in lateral view, are probably females.

Occurrence. Bairdia victrix has previously been reported by PURI (1960) from Florida Bay and by BRADY (1880) from the Caribbean near Colon, Panama, Culebra Island, West Indies, Azores, North Brazil, Kerguelen Island, Cuba, and the northwestern Gulf of Mexico (ROTHWELL, *in* TRESSLER, 1954). BRADY found the larger forms of this species commonly distributed in the southwestern Atlantic and perhaps over a larger area of the southern hemisphere, inhabiting water of considerable depth (390 to 900 fathoms). The large size (1.60 mm) of the forms he found may be due to the colder waters of these depths. Found in the eastern Gulf of Mexico throughout the north-south extent of the area of investigation; abundant at localities 8, 11, 15, 16, 20, and 29-31. Depth range 19 to 154 feet, although most abundant at depths greater than 65 feet; salinity range 36.17 to 39.36‰. Frequently associated with *Paracytheridea tschoppi, Bairdoppilata triangulata,* and *Bairdia* sp. cf. *B. bradyi*.

BAIRDIA sp. cf. B. BRADYI van den Bold, 1957

Pl. 2, Figs. 1-3; Fig. 7

Bairdia foveolata BRADY, 1868c, p. 56, pl. 7, figs. 4-6; ———, 1880, p. 55, pl. 8, figs. 1a-f, 2a-f.

non Bairdia foveolata BOSQUET, 1852, p. 21, pl. 1, fig. 5a-d. [=*Monsmirabilia foveolata* (Bosquet), APOSTOLESCU, 1955, p. 256, pl. 3, figs. 49-51; *Cuneocythere (Monsmirabilia) foveolata* (Bosquet), KEIJ, 1957, p. 79, pl. 9, figs. 8-11.]

?Bairdia foveolata Brady, CHAPMAN & CRESPIN, 1928, p. 169.

Bairdia bradyi VAN DEN BOLD, 1957, p. 236, pl. 1, fig. 5 [new name].

Diagnosis. Distinguished by its highly arched dorsum, coarsely punctate carapace, and radial-pore canals.

Description. Carapace medium-sized, robust, subtrigonal, subrhomboidal in dorsal view; left valve larger than right, overlapping right around entire periphery except extreme anterior and posterior, highest and widest centrally, subtriangular in lateral view; dorsal margin very strongly arched centrally, very slightly convex posteriorly, straight anteriorly; venter slightly convex; anterior margin broadly rounded; posterior obliquely rounded below, forming a slight subventral caudal extension. Surface marked by numerous large, irregularly arranged punctae. Carapace mostly translucent, with irregularly arranged opaque areas. Ornamentation restricted to antero- and posteroventral areas, with denticles on left valve and striate frills on right valve.

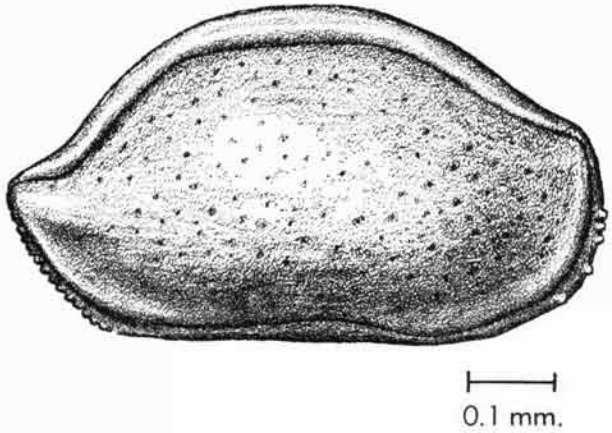


FIG. 7. *Bairdia* sp. cf. *B. bradyi* VAN DEN BOLD, 1957. Carbon sketch of the exterior lateral view of the right sides of a whole specimen showing the valve overreach of the left valve over the right.

Hinge typical of genus. Marginal area broad, with narrow vestibules developed anteriorly and posteriorly. Adductor muscle-scar pattern consisting of subcircular group of 7 slightly elongate scars, at center of which are 1 to 3 smaller, nearly circular scars. Radial-pore canals numerous, straight, and simple.

Dimensions. Length of complete carapace 0.71 mm; height 0.47 mm; width 0.39 mm.

Material. Specimens examined 87, of which 17 had both valves intact.

Remarks. This species exhibits most of the characteristics of *B. victrix*, but the presence of radial-pore canals and large punctae serve to distinguish it. Although none of the specimens found in the Gulf of Mexico approach the 1.1 mm length of those described by BRADY (1880), all other external features ally them to *B. bradyi* VAN DEN BOLD. BRADY gave no descriptions of internal characteristics. He interpreted this species to vary considerably in form and surface ornamentation and recognized at least 2 varieties. The criteria by which *Bairdia* is speciated (primarily shape and ornamentation) have not changed appreciably since the work of BRADY.

Occurrence. Bairdia foveolata was reported by BRADY (1880, p. 55, renamed *bradyi* by VAN DEN BOLD, 1957) from Bermuda, at a depth of 435 fathoms, and from several other widely separated localities, at depths ranging from 6 to 1,150 fathoms. He noted: "This is one of the more abundant forms of *Bairdia*, especially in the Southern Seas, and it seems to be subject to a great deal of variation, both in form and surface-ornament." Reported from Florida Bay by PURI (1960) and from the Miocene of Trinidad by VAN DEN BOLD (1957). Found in the eastern Gulf of Mexico throughout the north-south extent of the area of investigation; abundant at localities 1-5, 17, 27, 29, 30, and 35; most abundant in the southern part of the study area in waters less than 100 feet deep. Depth range from 19 to 92 feet, with single valves at 154 feet; salinity range 36.28 to 39.92‰. Frequently associated with *Bairdia victrix, Paracytheridea tschoppi, Aurila conradi floridana*, and *Bairdoppilata triangulata*.

BAIRDIA GERDA Benson & Coleman, n.sp.
Pl. 1, Figs. 14-16; Fig. 8

Diagnosis. Distinguished by its pyriform shape and elongate adductor muscle scars.

Description. Carapace moderately large, pyriform, subovate in dorsal view, highest and widest anterior to mid-line, pyriform in lateral view; dorsal margin consisting of 2 elements, posterior one being gently arched and converging rapidly with ventral margin, forming obtuse angle with straight anterior element; venter very slightly convex; anterior margin obliquely rounded below, forming obtuse angle with dorsal margin; posterior end narrowly rounded near venter. Surface marked by widely scattered, fine, normal-pore canals, through which rather coarse hairs project in living specimens.

Hinge typical of genus. Marginal area moderately broad, with narrow vestibules developed anteriorly and posteriorly. Adductor muscle-scar pattern consisting of circular group of 4 quite elongate scars, some of which are divided into smaller elongate scars in some specimens.

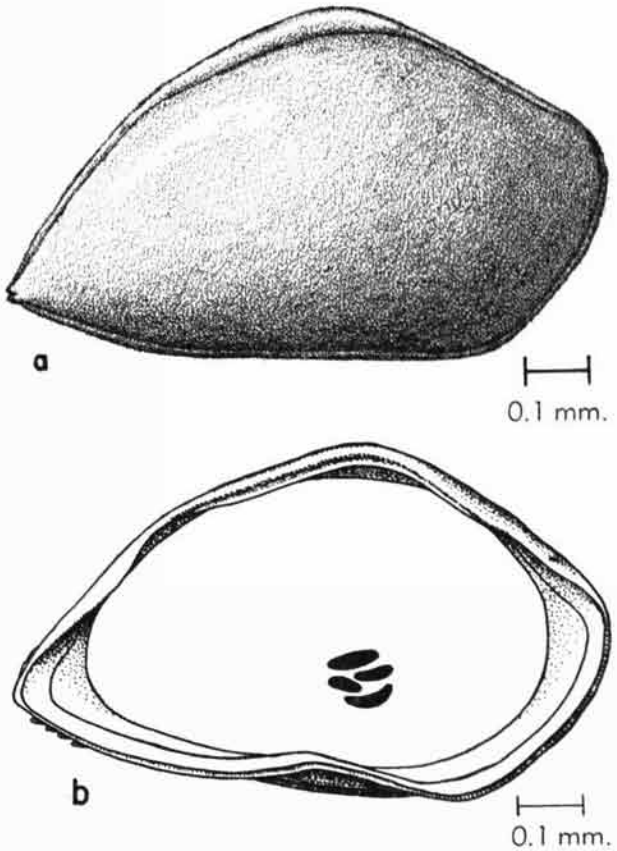


FIG. 8. *Bairdia gerda* BENSON & COLEMAN, n. sp.—*a*. Carbon sketch of the exterior lateral view of a whole specimen viewed from the right side.—*b*. Interior view of the left valve of an adult specimen.

Dimensions. Length of adult specimen 0.91 mm; height 0.53 mm; width 0.44 mm.

Material. Specimens examined 468, of which 155 had both valves intact.

Remarks. This species differs from most other species of *Bairdia*, including *B. curta* M'COY, in that the valves are subequal. No other species was observed to have so small a posterior angle between the dorsal and ventral margins. Named for the *Gerda*, research vessel of the University of Miami Marine Laboratory, from which all samples used in this investigation were collected.

PURI (1960, p. 130, pl. 6, figs. 11, 12) reported and illustrated a bairdiid from Florida Bay, which he identified as *Bairdia crosskeiana* BRADY [trivial name misspelled *crosskeyiana* by PURI, 1960; MÜLLER, 1912; also BRADY & NORMAN, 1889]. PURI did not describe

or discuss this form, which was originally found living in the waters of the Mediterranean, the Admiralty Islands, and Hawaii. After examination of specimens from Florida Bay we believe this new form is sufficiently distinct to be identified as a separate species that is probably closely related to *B. crosskeiana*. *B. gerda* has a truncated and faceted dorsum, as opposed to the evenly arched dorsum of *B. crosskeiana*. In dorsal view *B. crosskeiana* is compressed anteriorly, whereas *B. gerda* is evenly rounded, with both valves equal in size.

Occurrence. Found between latitudes 24° 59.0′ N and 28° 17.4′ N, this species constitutes about 80 percent of the ostracode fauna at locality 13, 60 percent at localities 11 and 40, and 33 percent at locality 12 in the areas just south of Charlotte Harbor in onshore waters. It is also very abundant at depths less than 50 feet; salinity range 34.86 to 39.92‰. Substrate predominantly fine-grained calcareous fragments. Often associated with *Loxocorniculum postdorsolatum*, *Haplocytheridea gigantea*, and *Aurila conradi floridana*.

Genus BAIRDOPPILATA Coryell, Sample & Jennings, 1935

Bairdoppilata CORYELL, SAMPLE & JENNINGS, 1935, p. 2; JENNINGS, 1936, p. 43; EDWARDS, 1944, p. 507; KEIJ, 1957, p. 53; POKORNÝ, 1958, p. 227; SHAVER, 1961, p. Q205; VAN MORKHOVEN, 1958, p. 367; REMENT & REMENT, 1959, p. 60.

Type-species. *Bairdoppilata martyni* CORYELL, SAMPLE & JENNINGS, 1935, p. 3, figs. 1, 2.

Diagnosis. Carapace with same characters as *Bairdia* except hinge, which has additional terminal elements, consisting of teeth on right valve and corresponding crenulate sockets on left valve, completing locks, which seem to serve as guides to keep valves from shifting on closure. *L. Cret.-Rec.*

Remarks. We question the validity of this genus as other than an artificial convenience. The locking teeth are probably developed on those bairdiids in which the hinge has become too short relative to the mass of the carapace for stability on closure.

BAIRDOPPILATA TRIANGULATA Edwards, 1944

Pl. 3, Figs. 1-3; Fig. 9

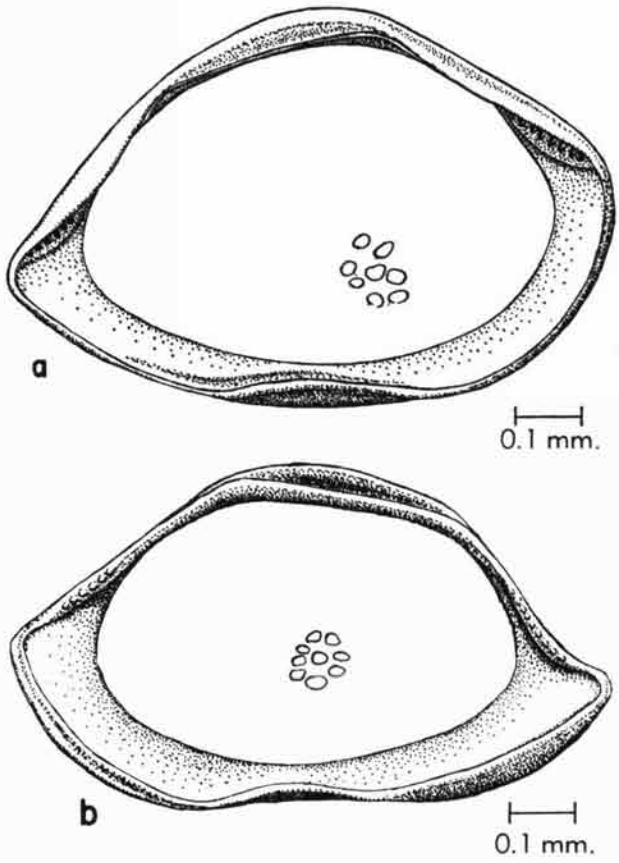


FIG. 9. *Bairdoppilata triangulata* EDWARDS, 1944.—*a*. Interior view of the left valve of an adult showing the "hinge" sockets under the flange near the anterior and posterior.—*b*. Interior view of the right valve of an adult showing the "hinge" teeth developed on the flange near the anterior and posterior.

EXPLANATION OF PLATE 1

CYTHERELLA, CYTHERELLOIDEA, PARACYPRIS, BAIRDIA

(All illustrated forms are from the eastern Gulf of Mexico, ×60)

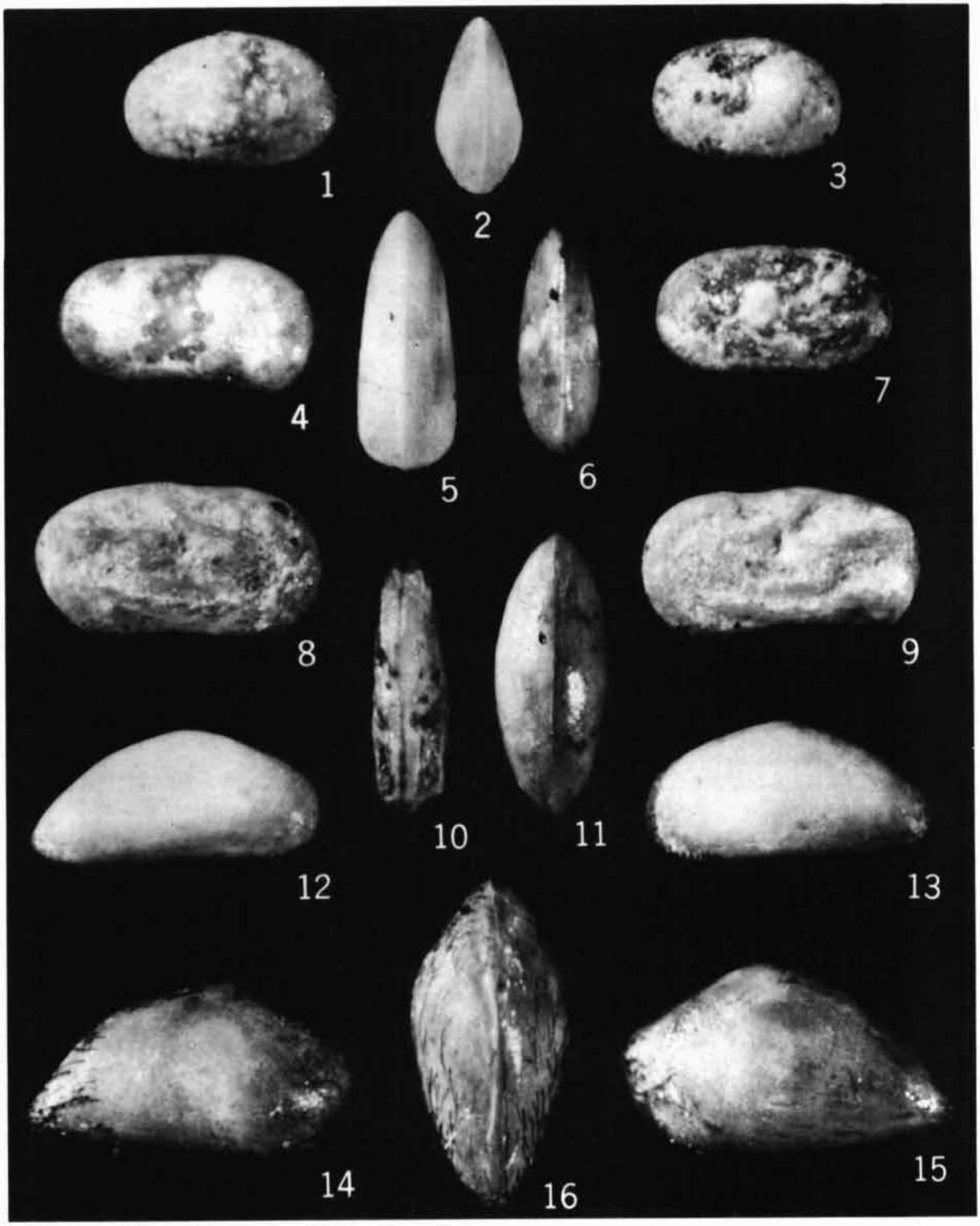
FIGURE — PAGE

1-7.—Cytherella grossmani BENSON & COLEMAN, n.sp.; *1*, exterior lateral view of right valve of an immature specimen; *2*, dorsal view of an immature specimen; *3*, exterior lateral view of left valve of an immature specimen; *4*, exterior lateral view of left valve of female; *5*, dorsal view of female; *6*, dorsal view of male; *7*, exterior lateral view of right valve of male 14

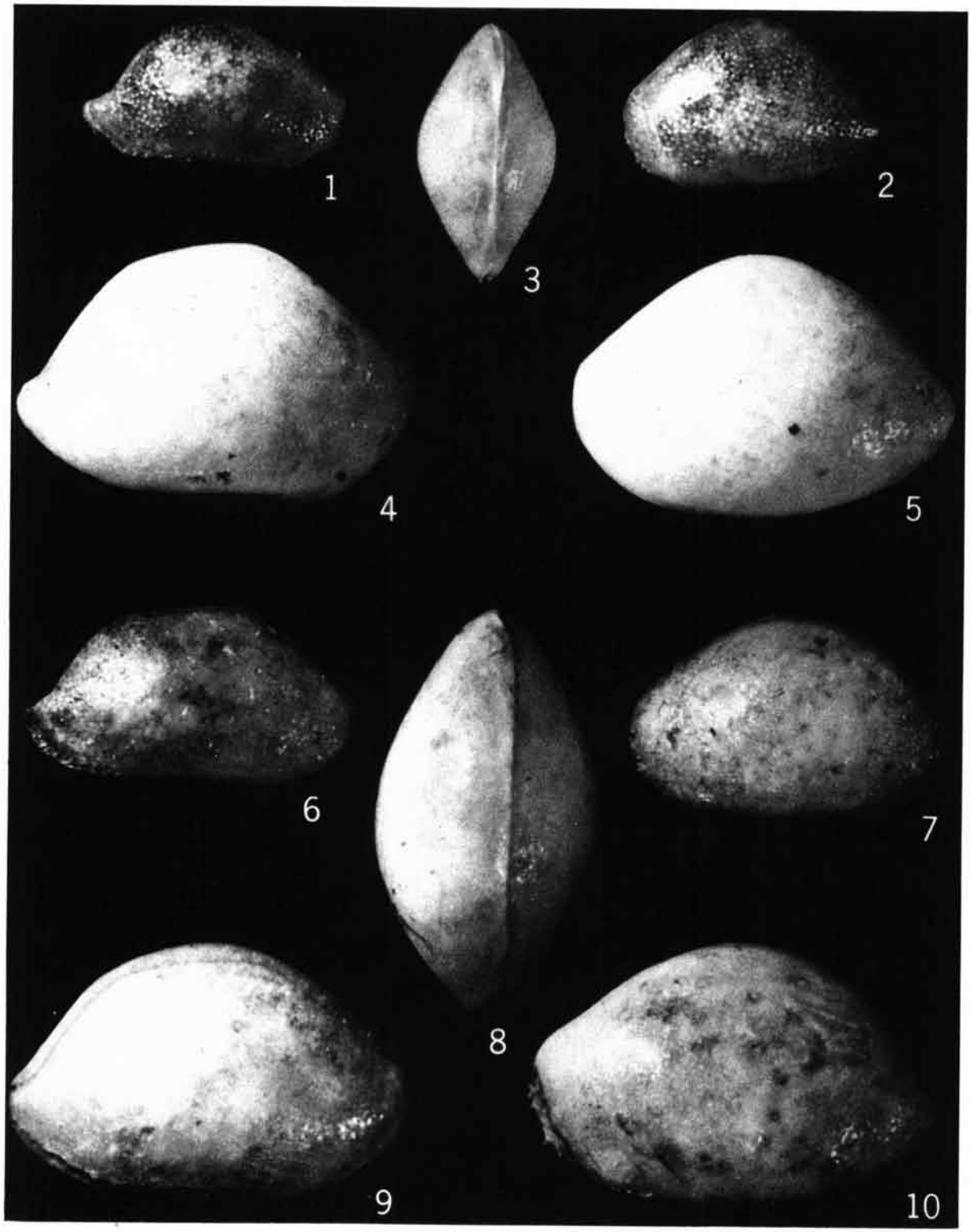
8-10.—Cytherelloidea sp. cf. *C. sarsi* PURI, 1960; *8*, exterior lateral view of right valve; *9*, exterior view of left valve; *10*, dorsal view 15

11-13.—Paracypris? sablensis BENSON & COLEMAN, n. sp.; *11*, dorsal view; *12*, exterior lateral view of right valve; *13*, exterior lateral view of left valve 16

14-16.—Bairdia gerda BENSON & COLEMAN, n.sp.; *14*, exterior lateral view of right valve; *15*, exterior lateral view of left valve; *16*, dorsal view 19



BENSON & COLEMAN — Recent Marine Ostracodes, Eastern Gulf of Mexico



BENSON & COLEMAN — Recent Marine Ostracodes, Eastern Gulf of Mexico

Bairdoppilata triangulata EDWARDS, 1944, p. 507, pl. 85, figs. 5-7; PURI, 1953d, p. 223, pl. 1, figs. 3, 4, text-figs. 1a,b.

Diagnosis. Distinguished by its subovoid to subtriangular, finely punctate carapace, subcircular muscle scars, and nearly straight posterodorsal margin. *Mio.-Rec.*

Dimensions. Length of complete carapace 0.91 mm; height 0.61 mm; width 0.48 mm.

Material. Specimens examined 65, of which 4 had both valves intact.

Remarks. Complete specimens of this species are very difficult to distinguish from *Bairdia victrix* BRADY, as most of the distinguishing features are internal: the presence of terminal taxodont dental elements, subcircular, instead of elongate muscle scars, and shell opacity limited to a keystone-shaped translucent area surrounding the muscle scars. The last can sometimes be seen from the exterior. *Bairdoppilata willisensis* PURI, 1953, has a more bluntly rounded posterior margin.

Occurrence. Not previously reported from Recent sediments. Reported by EDWARDS (1944, p. 507) from the Miocene Duplin Marl of North Carolina, and by PURI (1953d, p. 225) from the *Ecphora* and *Cancellaria* facies of the Choctawhatchee Stage of the Miocene of Florida. Found in the eastern Gulf of Mexico from latitude 24° 59.0′ N to the northern edge of the area of investigation; most abundant at localities 27, 29-31; found also at localities 4, 8, 32-34. Depth range 19 to 239 feet, although most common at depths greater than 60 feet, particularly in the northern part of the study area; salinity range 36.17 to 39.36‰. Almost always associated with *Echinocythereis garretti* and often with *Paracytheridea tschoppi, Bairdia* sp. cf. *B. bradyi,* and *Bairdia victrix.*

Superfamily CYTHERACEA Baird, 1850
Family BRACHYCYTHERIDAE Puri, 1954

Genus PTERYGOCYTHEREIS Blake, 1933

Pterygocythereis BLAKE, 1933, p. 239; TRIEBEL, 1941, p. 385; VAN DEN BOLD, 1946, p. 29; SYLVESTER-BRADLEY, 1948, p. 793; KEIJ, 1957, p. 94; POKORNÝ, 1958, p. 262; HOWE, 1961, p. Q262.

Type-species. Cythereis jonesii BAIRD, 1850, p. 175, pl. 20, fig. 1.

Diagnosis. Distinguished from other genera of the Brachycytheridae by its holamphidont hinge and subovate, plate-ornamented carapace, which is subtriangular or arrow-shaped in dorsal view because of development of prominent ventrolateral spines or alae. Surface generally smooth except for marginal crests, plates, or terminal spines. *Mio.-Rec.*

Ecology. This genus is believed to be exclusively marine and associated with fine-grained sediments.

Remarks. The type-species, *Cythereis jonesii* BAIRD, 1850, was originally spelled with two "i"s. According to the Rules of Zoological Nomenclature all later spellings with one "i" are junior homonyms.

PURI (1960, p. 129) has pointed to the confusion existing in past definitions of the type-species and difficulties of identifying new forms. OERTLI (1957) showed the usefulness of the dorsal crest in distinguishing among several of the older Tertiary species.

In our own study it was necessary to examine topotype specimens of *Pterygocythereis jonesii* (BAIRD) to distinguish *P. americana* (ULRICH & BASSLER) as a separate species. *P. americana* is closely related to *P. jonesii* in that both species have forms with fluted and platelike dorsal crests and alar flanges. The dorsal crest of *P. americana* is fused, with perforations at the base. It is divided at only one place. The crest of *P. jonesii* consists of aligned discrete platelike spines. The frill or flange along the ala of *P. americana* is fluted and fused, whereas that of *P. jonesii* again consists of discrete platelike spines. Just behind the ala one or at most two spines may be present in *P. americana,* whereas as many as five or six may be present in *P. jonesii.* A spine at the posterior cardinal angle is rare in *P. americana,* but it is always present in

EXPLANATION OF PLATE 2

BAIRDIA

(All illustrated forms are from the eastern Gulf of Mexico, ×60)

FIGURE — PAGE

1-3.—Bairdia sp. cf. *B. bradyi* VAN DEN BOLD, 1957; *1,* exterior lateral view of right valve; *2,* exterior lateral view of left valve; *3,* dorsal view 18

4-10.—Bairdia victrix BRADY, 1869; *4,* exterior lateral view of right valve of adult female(?); *5,* exterior lateral view of left valve of adult female(?); *6,* exterior lateral view of right valve of an immature specimen; *7,* exterior lateral view of left valve of an immature specimen; *8,* dorsal view of adult male(?); *9,* exterior lateral view of a complete adult male(?), showing overlap of left valve; *10,* exterior lateral view of left valve of adult male(?) 17

mature instars of *P. jonesii*. Thus far an unquestioned *P. jonesii* has not been reported from North America. The form illustrated by PURI (1960, text-fig. 26) is conspecific with the form described in this report.

PTERYGOCYTHEREIS sp. aff. P. AMERICANA (Ulrich & Bassler), 1904

Pl. 5, Figs. 1-3; Fig. 10

Diagnosis. This form of *Pterygocythereis* can be distinguished by the presence of an *en echelon* fluted and divided crest in the heteromorph. The dorsal crest is absent in the adult tecnomorph, and one or two spines are present on the main part of the carapace just behind the ala.

Description. Like *Pterygocythereis americana* (ULRICH & BASSLER) as previously described in general shape, but smaller in size. Surface smooth, ornamented on each valve by large, back-swept, sharp, pointed ala with fluted forward leading edge; posterior edges of alae merging with domicilium, but juncture punctuated by short spine; posterior produced, with five platelike spines emerging from posteroventer on submarginal flange, which is continuous around free margin and separated into six or seven platelike spines along anteroventer. In tecnomorphs eye tubercle grades into postjacent low ridge that runs along straight dorsal margin in position of dorsal crest, over prominent and spineless posterocardinal angle, and along truncate posterodorsum in same manner as *P. cornuta* (ROEMER).

Among larger instars, specimens were found with mature holamphidont hinge and divided fluted crest, of which segments are oriented *en echelon* with dorsal margin. These specimens are similar to uncrested forms in every respect, except that a few specimens have two post-alate spines instead of one; spine sometimes found on posterior cardinal angle of left valve.

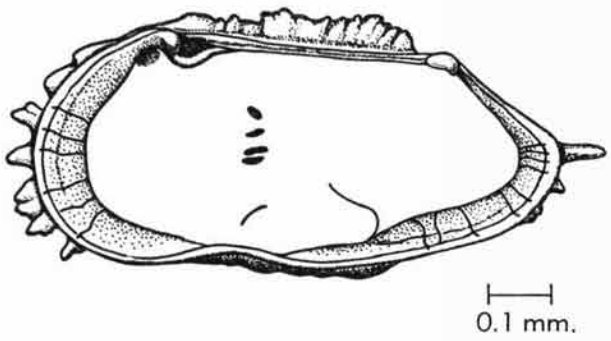


FIG. 10. *Pterygocythereis* sp. aff. *P. americana* (ULRICH & BASSLER), 1904. Interior view of the right valve of an adult specimen with an *en echelon* fluted crest.

All instars found, with one exception, lack the dorsal crest, being identical in external form to the adult described below. Internally carapace resembles that of specimens of *P. americana* described from the Miocene of the East Coast but is slightly thinner and more fragile.

Dimensions. Length of complete adult specimen 0.86 mm; height 0.45 mm; width 0.70 mm.

Material. Specimens examined 103, of which only 2 had both valves intact. Seven had *en echelon* dorsal crests.

Remarks. About the same number of adult specimens of *Pterygocythereis americana* were found without the characteristic *en echelon* crest as were found with it. No one has previously reported uncrested forms from Neogene strata. Upon examination of specimens of *P. americana* in our collections from the Miocene of Virginia, North Carolina, South Carolina, and Florida, we found no uncrested forms, even among the earlier instars. Also, these fossil specimens are larger on the average than uncrested forms described here. The crested forms in waters of the Gulf of Mexico are the same in size as the uncrested forms. The forms illustrated by MCLEAN (1957) and MALKIN (1953) show no post-alate spines, nor do the specimens we have from the Miocene.

The uncrested tecnomorph is remarkably similar to the Eocene-Oligocene form *Pterygocythereis cornuta* (ROEMER), 1838, as described and illustrated by KEIJ (1957, p. 94, pl. 13, fig. 13, jl. 14, fig. 5) and as illustrated by OERTLI (1956, pl. 11, fig. 302). Even though ULRICH & BASSLER originally designated *P. americana* as a subspecies of *P. cornuta,* the identification of the Recent form of *P. americana* with the Paleogene *P. cornuta* is dubious. The lack of a dorsal crest is characteristic of *P. cornuta;* however, other features, such as ornamentation of the upper surface of the alae, may be used to distinguish *P. cornuta* from the present form.

Occurrence. Pterygocythereis americana has been reported previously from Recent sediments by CURTIS (1960) from the Mississippi Delta. It was originally described by ULRICH & BASSLER (1904, p. 122) from the Miocene of Maryland and has been reported by other writers only from Miocene sediments: in Florida, from the Chipola and Shoal River facies of the Alum Bluff Stage, and from the *Arca, Ecphora,* and *Cancellaria* facies of the Choctawhatchee Stage, by HOWE AND OTHERS (1935, p. 26) and by PURI (1953d, p. 261). The presently described form has been found in the eastern Gulf of Mexico throughout the north-south

extent of the area of investigation; very abundant at localities 20 and 30, somewhat less abundant at localities 21, 27, 33, and 34. Depth range 19 to 239 feet, although much more abundant at depths greater than 75 feet and less than 100 feet; salinity range 36.17 to 39.41‰. Usually associated with *Echinocythereis garretti* and *Paracytheridea tschoppi*.

Family CAMPYLOCYTHERIDAE Puri, 1960

[*Nom. transl.* BENSON & COLEMAN, herein (*ex* Campylocytherinae PURI, 1960) (=Leguminocytheridae HOWE, 1961, p. Q306 =Campylocytheridae HOWE, 1961, p. Q326); corrected but not emended by HOWE, 1962, p. 35.]

Diagnosis. The concept of the family Campylocytheridae PURI is herein emended to allow this taxon to accept genera with the following characteristics. Carapace elongate-ovate in lateral and dorsal views, with smooth to reticulate surfaces. Hinge modified holamphidont with anterior socket of right valve subtriangular; apex of subtriangular socket elongated in direction of median hinge groove and becoming part of it; venter of anterior hinge socket and median groove bounded by ridge, in some forms reinforced by underlying camlike element referred to as "antislip tooth." Marginal areas wide, duplicature being partially or entirely fused. *Eoc.-Rec.*

Remarks. PURI (1960, p. 127) established the subfamily Campylocytherinae to receive the genera *Campylocythere* EDWARDS, *Acuticythereis* EDWARDS (which we believe to be synonymous with *Campylocythere* EDWARDS), *Basslerites* HOWE, *in* CORYELL & FIELDS, 1937 (*non Basslerella* HOWE, 1935, July, as given by PURI; this name is the junior homonym of *Basslerella* KELLETT, 1935, March), *Buntonia* HOWE, and *Thalmannia* LEROY. All of these forms are essentially elongate-ovate with smooth to punctate carapace possessing a holamphidont hinge. PURI did not discuss the significance of modifications of this hinge.

HOWE (1961, p. 306) established the new subfamily Leguminocythereididae to receive the genera *Leguminocythereis, Acuticythereis, Basslerites, Campylocythere,* and *Triginglymus,* as all of these forms are similar in shape and have a characteristically triangular anterior socket and groove in the right valve. HOWE was apparently unaware of PURI's subfamily Campylocytherinae.

We agree basically with the concept and the taxonomic category proposed by HOWE. The family Campylocytheridae PURI is therefore proposed to include *Campylocythere* (=*Acuticythereis*), *Basslerites, Leguminocythereis (sensu stricto),* and *Triginglymus.* We believe that many of the species assigned by KEIJ (1957), BENSON (1959) and others to *Leguminocythereis* should be assigned elsewhere to genera with trachyleberid holamphidont hinges, as they do not have the hinges described above. Also the assignment of *Buntonia* and *Thalmannia* to this group, as suggested by PURI, is questionable, since these genera do not have campylocytherid hinges.

Genus CAMPYLOCYTHERE Edwards, 1944

Campylocythere EDWARDS, 1944, p. 514; VAN DEN BOLD, 1946, p. 31; MALKIN, 1953, p. 784; SWAIN, 1955, p. 636; POKORNÝ, 1958, p. 271; HOWE, 1961, p. Q307.

Acuticythereis EDWARDS, 1944, p. 519; MCLEAN, 1957, p. 90; HOWE, 1961, p. Q307.

Type-species. Campylocythere laeva EDWARDS, 1944, p. 515, pl. 86, figs. 8-14.

Diagnosis. Carapace subpyriform to elongate; highest in anterior; anterior margin moderately to strongly produced and moderately rounded, oblique in some; posterior subtriangular, produced medially; left valve overreaching right at anterior cardinal angle; surface smooth, punctate, or pitted, rarely with fine reticulation; tendency toward concentration of punctae toward posterior observed in many species. Hinge holamphidont, with anterior pyramidal tooth in right valve, followed by postjacent socket opening into wedge-shaped crenulate groove; position of hinge toward posterodorsum and elongation of its anterior elements correlatable with development of produced anterior part of carapace. Small to enlarged vestibule; radial-pore canals straight, simple, and singular, in pairs, in triplets, with common origins or mixed depending on increased size of vestibule. *Mio.-Rec.*

Remarks. We have followed MALKIN (1953, p. 784) and SWAIN (1955, p. 636) by including *Acuticythereis* in synonomy with *Campylocythere.* We do not believe sufficient differences exist between these forms to justify separate categories. It is unfortunate that the type-species of the genus (*Campylocythere laeva* EDWARDS) is not morphologically average for the group including *Acuticythereis,* but it is nevertheless contiguous with it. The only basic difference between *C. laeva* and *C. laevissima* (the type-species of *Acuticythereis* EDWARDS) is that *C. laeva* is produced anteriorly, elongating and accentuating the anterior elements of the hinge for strength. All of the differences considered diagnostic by HOWE (1961, p. Q307) and PURI (1960, p. 128) are functions of this anterior elongation, with possible exception of the tripartite radial-pore canals. This last feature was not found to be present in many of the specimens examined by us, even within the same population studied by PURI.

We judge that the generic concept for *Acuticythereis* given by PURI cannot be applied consistently, as can be demonstrated by the case of the form he identified as *Campylocythere laeva* from the Florida Bay and Alligator Harbor areas. He suggested that slight differences distinguish his specimens of *C. laeva* from the types; however, the form illustrated by him is closer by his own standards to *C. laevissima* than to *C. laeva*. The difficulty of adequately distinguishing between these species, which are the type-species of the disputed genera, suggests the closeness of their relationship. If males and females of the same species of fossil can be separately classified in different genera on the basis of elongation of their carapaces, and consequently of their hinges, the criteria for generic distinction must be examined more closely.

The assignment of *Campylocythere* and *Acuticythereis* as junior subjective synonyms of *Cytheretta* by KASHEVAROVA, MANDELSTAM, & SCHNEIDER (1960) is not in keeping with the common understanding of these categories.

CAMPYLOCYTHERE LAEVISSIMA (Edwards), 1944

Pl. 4, Figs. 6, 8, 9; Fig. 11

Acuticythereis laevissima EDWARDS, 1944, p. 519, pl. 87, figs. 4-11; MCLEAN, 1957, p. 90, pl. 12, fig. 4a-g; PURI, 1960, p. 128, pl. 2, fig. 16, 17; CURTIS, 1960, p. 479, pl. 2, fig. 1 (bottom).

Acuticythereis laevissima punctata EDWARDS, 1944, p. 520, pl. 87, fig. 12, 13.

Campylocythere laevissima (Edwards), MALKIN, 1953, p. 785, pl. 80, figs. 4-6; PURI & HULINGS, 1957, p. 174, 176, 183.

Campylocythere laeva Edwards, PURI, 1960, p. 128, pl. 2, figs. 1, 2, text-figs. 12, 13; PURI & HULINGS, 1957, p. 187, fig. 11.

Diagnosis. Distinguished by its ovate to pyriform, moderately shortened anterior region. Surface smooth, with irregularly spaced normal-pore canals; heteromorphs with finely punctate posterior; posterior end of right valve pointed, of left valve rounded. *Mio.*

Dimensions. Length of adult specimen 0.66 mm; height 0.38 mm; width 0.32 mm.

Material. Specimens examined 56, of which 24 had both valves intact.

Remarks. Specimens collected in the Gulf of Mexico are not as elongate as those described by EDWARDS (1944) and MALKIN (1953), but all other features appear identical. The normal-pore canals are more concentrated in the posterior area than in other parts of the carapace. Some specimens are more inflated in the rear than others. These same forms are finely punctate in the posterior region, whereas the uninflated forms have irregularly distributed, very fine punctae throughout, reflecting the distribution of the normal-pore canals. EDWARDS (1944, p. 515, 520) found a posteriorly punctate variant with the non-

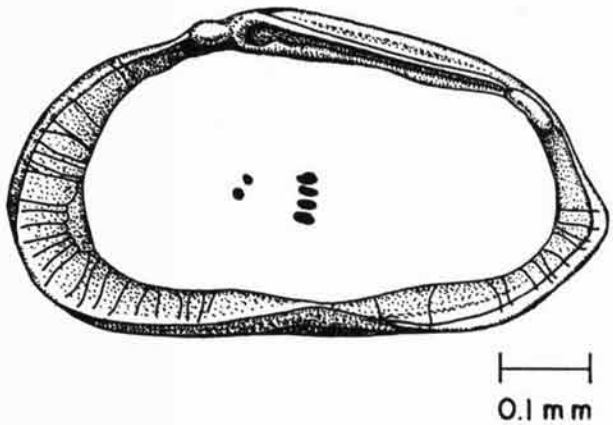


FIG. 11. *Campylocythere laevissima* (EDWARDS), 1944. Interior view of the right valve of an adult specimen showing the marginal area and hinge, particularly the anterior socket running into the broad hinge groove.

punctate form in both *Campylocythere laeva* and *"Acuticythereis" laevissima*. This is clearly not a subspecific difference, as the forms are consistently associated with one another. As this variation seems to exist in three of EDWARDS' species (including *C. multipunctata*) and is present in the Gulf species, we suggest that it is a characteristic of diagnostic value at the generic level.

PURI (1960, p. 128) has identified both *Campylocythere laeva* and *"Acuticythereis" laevissima* from Alligator Harbor, Tampa Bay, and Florida Bay. From our study of the variation in form of this latter species, we identify it as *Campylocythere laevissima,* occurring in much of this same area, and from examination of PURI's illustrations we conclude that *C. laevissima* has a considerable range in shape but not sufficient to be interpreted as *C. laeva*. Figure 12b of PURI (1960) shows a trilobate anterior tooth on the left valve of *"Campylocythere laeva"* that is not present in our specimens, although they are similar in every other respect.

Occurrence. Reported from the Miocene Duplin Marl of North Carolina by EDWARDS (1944, p. 515), from the Yorktown Formation of New Jersey, Maryland, and Virginia by MALKIN (1953, p. 785), and from Florida Bay and the Panama City and Alligator Harbor areas of the Gulf of Mexico by PURI & HULINGS (1957, p. 176, 183) and PURI (1960, p. 128). Found in the eastern Gulf of Mexico from the southern edge of the area of investigation north to latitude 28° 23.2′ N; complete carapaces found at localities 3-5, 18, 26, 27, 36, and 40. Depth range 19 to 95 feet, although most abundant at depths less than 25 feet; salinity range 34.86 to 39.92‰.

Family CYTHERETTIDAE Triebel, 1952

Genus CYTHERETTA Müller, 1894

Cytheretta MÜLLER, 1894, p. 382; ———, 1912, p. 366; EDWARDS, 1944, p. 524; VAN DEN BOLD, 1946, p. 27; PURI, 1952a, p. 202; TRIEBEL, 1952, p. 16; PURI, 1953d, p. 281; KEIJ, 1957, p. 131; PURI, 1958b, p. 186; POKORNÝ, 1958, p. 293; HOWE, 1961, p. Q270.

Pseudocytheretta CUSHMAN, 1906, p. 382.

Cylindrus NEVIANI, 1928, p. 106.

Prionocytheretta MÉHES, 1941, p. 60.

Type-species. Cytheretta rubra MÜLLER, 1894, p. 382, pl. 8, fig. 9, 10, 13, 16; pl. 39, fig. 8-22, 24. [=*Cytherina subradiosa* ROEMER, 1838, p. 517, pl. 6, fig. 20; subsequent designation by RUGGIERI, 1950, p. 9].

Diagnosis. Recognized by its elongate-ovoid, smooth, punctate, or subreticulate carapace. Hinge holamphidont; that of right valve generally consisting of prominent triangular anterior tooth, postjacent socket, smooth median groove, and large rounded posterior tooth. Marginal area broad and irregular; line of concrescence coincident with inner margin throughout, S-shaped anteriorly. Radial-pore canals numerous, curved, commonly branching, thickened in middle. Muscle-scar pattern consisting of posterior vertical row of four scars with single reniform or V-shaped antennal scar in front and mandibular scars near ventral inner margin. *Eoc.-Rec.;* Marine.

CYTHERETTA? SAHNII Puri, 1952

Pl. 5, Figs. 4, 6, 8; Fig. 12

Cytheretta sahnii PURI, 1952a, p. 206, pl. 39, figs. 7, 8, text-figs. 1, 2; ———, 1953d, p. 284, pl. 8, figs. 7, 8.

Diagnosis. Distinguished by its large carapace, ornamented near center by two fine, sinuous, obliquely longitudinal ribs separated by broad flat-bottomed depression; surface covered by longitudinal subparallel striations below lower rib.

Dimensions. Length of adult specimen 1.11 mm; height 0.59 mm; width 0.52 mm.

Material. Specimens examined 100, of which 24 had both valves intact.

Remarks. This species differs from *Cytheretta bassleri* HOWE, 1935, in having a well-defined depression between the two central sinuous ribs, and from *C. bassleri* and *C. okaloosaensis* SMITH, 1941, in having the ventral portion of the carapace striated.

The generic assignment of this species is questioned because (1) the surface is ribbed, even though generally smooth, (2) the hinge possesses several acessory elements unusual for species of *Cytheretta,* and (3) the inner margin is even, and not irregular as characteristic of *Cytheretta.*

The hinge of the form included in this report is complex. In the left valve it consists of a swelling in the selvage just in front of the anterior socket, an incompletely enclosed anterior socket with overlying selvage, a postjacent tooth, a hinge bar that forms the intermediate hinge element, and a posterior socket with small postjacent toothlet formed from the selvage.

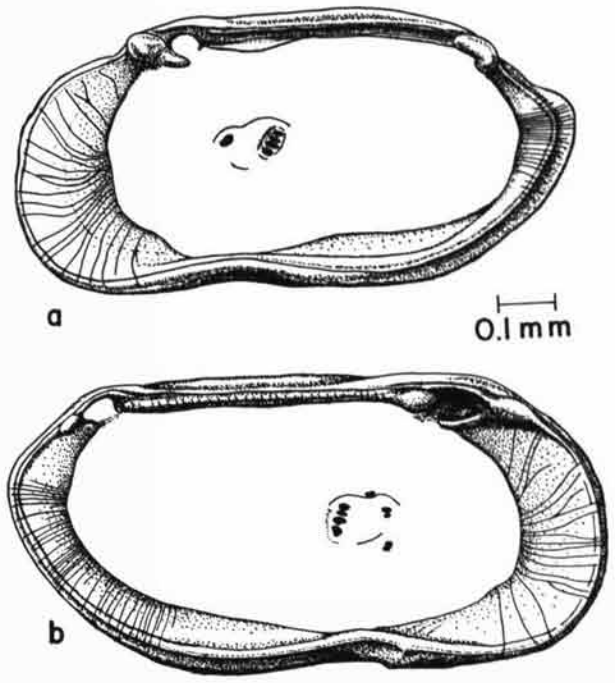


FIG. 12. *Cytheretta? sahni* PURI, 1952.—*a.* Interior view of the right valve of an adult specimen. [Note the small flange present under the anterior section of the hinge groove.]—*b.* Interior view of the left valve of an adult specimen showing the complex holamphidont hinge [described in the text] and the camlike structure at the ventral sinuation.

The flange of the left valve in the region of the ventral sinuation is also unusual, in that a large camlike structure serves to reinforce and assist closure of the valves.

Occurrence. Reported by PURI (1952a, p. 207; 1953d, p. 285) from the *Ecphora* and *Cancellaria* facies of the Choctawhatchee Stage of the Miocene of Florida. Found in the eastern Gulf of Mexico between latitudes 26° 13.3′ N and 28° 03.3′ N; abundant inshore at localities 15-18, 24, and 38 near Tampa Bay, and 36 and 37 south of Sanibel Island. Depth range 20 to 63 feet, although most abundant at depths of less than 35 feet; salinity range 36.23 to 37.84‰. Commonly associated with *Cytherura johnsoni, Paracytheridea tschoppi, Paracypris? sablensis, Hulingsina ashermani, Haplocytheridea gigantea,* and *H. proboscidiala.*

Genus PROTOCYTHERETTA Puri, 1958

Protocytheretta PURI, 1958b, p. 188; HOWE, 1961, p. Q271.
Type-species. Cythere daniana BRADY, 1869, p. 124, pl. 14, figs. 13, 14.

Diagnosis. Carapace cytherettid in shape and hingement, with reticulate surface ornamented by three prominent longitudinal ribs. *Olig.-Rec.*

Remarks. Protocytheretta is distinguished from *Paracytheretta* by the presence of a noncrenulate posterior tooth in the right valve. Some difference of opinion exists about the nature of the generic distinguishing feature of the type-species of *Paracytheretta* (*P. reticosa* TRIEBEL, 1941, p. 389). TRIEBEL (1941, p. 390) described the posterior tooth as "plump trapezförmig." PURI, after examining specimens from the Danish Paleocene identified as the type-species, concluded that the posterior tooth was crenulate and that the category *Paracytheretta* should be restricted to forms with a hemiamphidont hinge, which are possibly ancestral to his new genus *Protocytheretta.*

The hinge of forms found within the family Cytherettidae is more varied and more complex than has been previously noted. From examination of specimens in the senior author's collection and from drawings of KEIJ (1957), it has become apparent to us that the present simple amphidont hinge classification is insufficient to encompass the more advanced cytherettid hinges, and that much study of the evolution of the hinge, correlated with development of surface ornamentation, is necessary before the ancestry of *Protocytheretta daniana* and related species can be determined.

PROTOCYTHERETTA DANIANA (Brady), 1869

Pl. 5, Figs. 5, 7, 9, 10; Fig. 13

Cythere daniana BRADY, 1869, p. 124, pl. 14, figs. 13, 14.
Paracytheretta daniana (Brady), PURI, 1952a, p. 210, pl. 40, figs. 10, 11, text-fig. 11.
Cytheretta daniana (Brady), PURI & HULINGS, 1957, p. 174, 187, fig. 11; CURTIS, 1960, p. 481, text-fig. 9, pl. 2, fig. 2 (top).
Protocytheretta daniana (Brady), PURI, 1958b, p. 188, pl. 3, figs. 7-11; ———, 1960, p. 111, pl. 1, figs. 1, 2, text-figs. 18-19.

Diagnosis. Distinguished by its large carapace, ornamented by reticulate pattern of elongate pits arranged concentrically about center of valve; two smooth, distinct, longitudinal ridges extending from anterior region to near posterior extremity, joining to form loop, these ridges being lower on right valve than left. Posterior margin of right valve produced, denticulate. Selvage of right valve turns dorsally in front of posterior margin, forming flattened area.

Discussion of hinge. The hinge of *Protocytheretta daniana* is unusual in that (1) a holamphidont protogenic stage occurs in the hinge ontogeny, and (2) the mature hinge of the left valve is complex, including a tooth in front of the anterior socket, which is developed from the selvage, a toothlet that terminates an incomplete socket lock under the anterior socket, and an elongate tooth at the posterior end of the hinge bar caused by thickening of this element. The protogenic hinge is not completely holamphidont in the strict sense but is well advanced over similar stages in other cytheraceans having an *"Archicythereis"* hingement. The hinge of *P. daniana* appears to be very advanced in the general evolution of cytherettid hinges.

Dimensions. Length of adult specimen 0.92 mm; height 0.53 mm; width 0.47 mm.

Material. Specimens examined 111, of which 21 had both valves intact.

Remarks. This species is very similar to *Protocytheretta karlana* (HOWE & PYEATT), 1935, figured but not described by PURI (1953) and by SWAIN (1951) from the Miocene of Florida and North Carolina. *P. karlana* is reticulate and ridged in a way similar to *P. daniana;* however, the ridges are not as distinct and discrete on the former as the latter, particularly the lower of the two major and central horizontal ridges, which form more of a posterolateral swelling on *P. karlana.* These two ridges are not united in a loop in *P. karlana* as in *P. daniana;* also, a ventrolateral depression is under the posterior swelling of *P. karlana.* In *daniana* the two major horizontal ridges are united to form a loop just behind the widest part of the carapace, converging with the general reticulate surface in the anterior region.

BRADY (1866, p. 379, pl. 61, fig. 3) described and illustrated a species from Turks Island in the Bahamas and near Cuba, which he called *Cythere pumicosa.* This form appears to be very much like *Cythere daniana* described from Veracruz, Mexico, three years later. TRESSLER (1954, p. 435) also listed *pumicosa* from the northwestern Gulf of Mexico. These two species may be the same. The types will have to be examined to decide if they are synonymous.

Occurrence. Previously reported from the Pliocene Caloosahatchee Marl of Florida by PURI (1958b); from the Recent of Alligator Harbor, Florida, by PURI (1958b, 1960) and PURI & HULINGS (1957); from the Mississippi Delta by CURTIS (1960); and from the Caribbean by BRADY (1869). Found in the eastern Gulf of Mexico from latitude 25° 29.0′ N to the northern edge of the area of this investigation; particularly abundant in the nearshore areas south of Tampa Bay;

abundant at localities 8, 16-18, 20, 21, 27, 30, 33, 34, and 42. Depth range 24 to 131 feet, although most abundant at depths between 50 and 70 feet; salinity range 36.00 to 37.39‰. Frequently associated with *Paracytheridea tschoppi, Echinocythereis garretti, Hulingsina ashermani,* and *Bairdoppilata triangulata.*

Family CYTHERIDEIDAE Sars, 1925
Subfamily CYTHERIDEINAE Sars, 1925
Genus HAPLOCYTHERIDEA Stephenson, 1936

Cytheridea BOSQUET (part), 1852, p. 37.
Cytheridea (Haplocytheridea) STEPHENSON, 1936, p. 700.
Cytheridea (Leptocytheridea) STEPHENSON (part), 1937, p. 156.
Cytheridea (Phractocytheridea) SUTTON & WILLIAMS, 1939, p. 571.
Haplocytheridea STEPHENSON, 1944a, p. 159; EDWARDS, 1944, p. 508; STEPHENSON, 1946, p. 321; GOERLICH, 1956, p. 138; SWAIN, 1955, p. 617; OERTLI, 1956, p. 42; KEIJ, 1957, p. 59; BENSON, 1959, p. 48; POKORNÝ, 1958, p. 245; HOWE, 1961, p. Q276.
Type-species. Cytheridea montgomeryensis HOWE & CHAMBERS, 1935, p. 17, pl. 1, fig. 1, pl. 2, figs. 1-3, 7, 9, pl. 6, figs. 17, 18.

Diagnosis. Recognized by its elongate-subovoid or subtriangular carapace. Hinge holomerodont, in right valve consisting of terminal crenulate teeth separated by crenulate bar. Marginal area moderately broad, with vestibule, if developed, anterior only; radial-pore canals numerous, irregularly spaced. *U.Cret.-Rec.*

Ecology. This genus appears to be restricted to shallow marine or slightly brackish water.

HAPLOCYTHERIDEA GIGANTEA Benson & Coleman, n. sp.
Pl. 3, Figs. 10-14; Fig. 14

Diagnosis. Distinguished by its large size, elongate surficial pits coincident with normal-pore canals, large number of crenulations on anterior dental element, large number of denticles at anteroventral margin, and small lenticular depression in posteroventral section of selvage of right valve.

Description. Carapace very large, strong, subovoid, elliptical in dorsal view; left valve slightly larger than right, overlapping right anterodorsally and mid-ventrally, highest and widest near mid-line. Subovate in

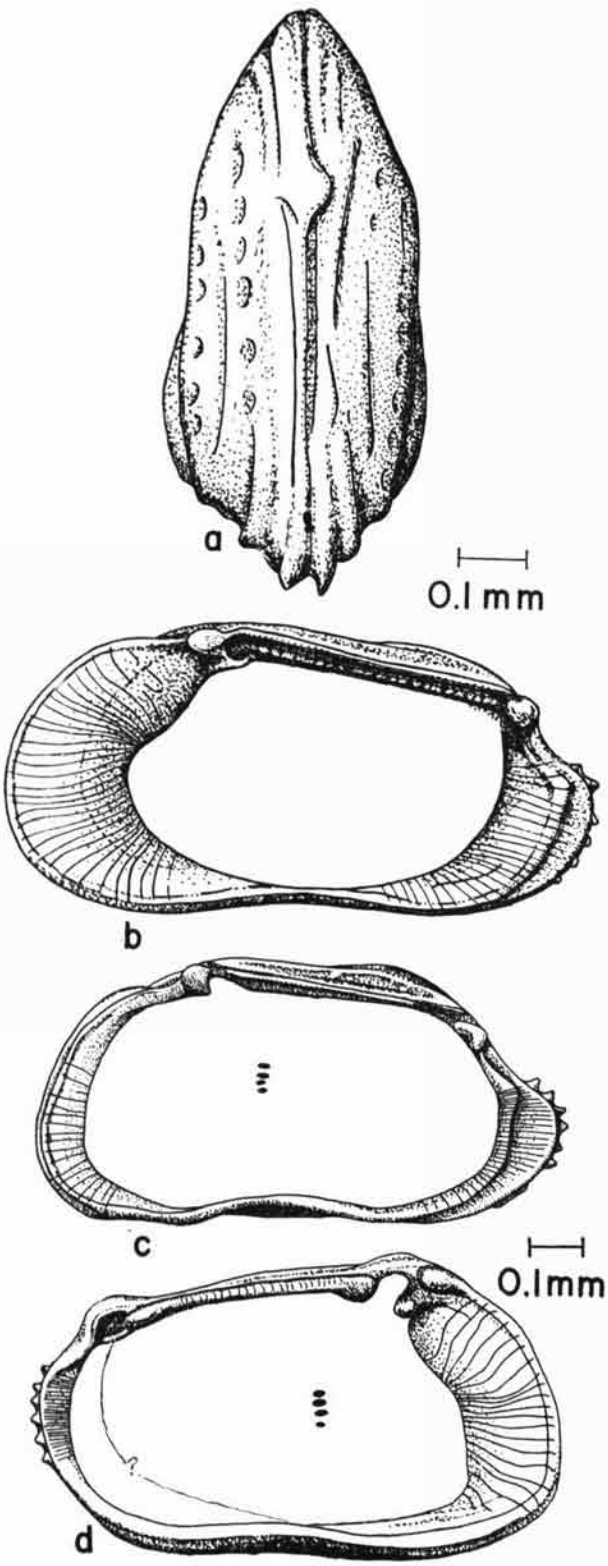


FIG. 13. *Protocytheretta daniana* (BRADY), 1869.—*a.* Generalized dorsal view of an adult male carapace.—*b.* Interior view of the right valve of an adult male showing a typical mature holamphidont hinge.—*c.* Interior view of the right valve of an immature male(?) specimen showing the protogenic hinge typical of this species.—*d.* Interior view of the left valve of an adult female. Note the complex dentition around the anterior socket assisting the small tooth at the anterior end of the hinge bar and the elongate tooth formed at the posterior end of the hinge bar.

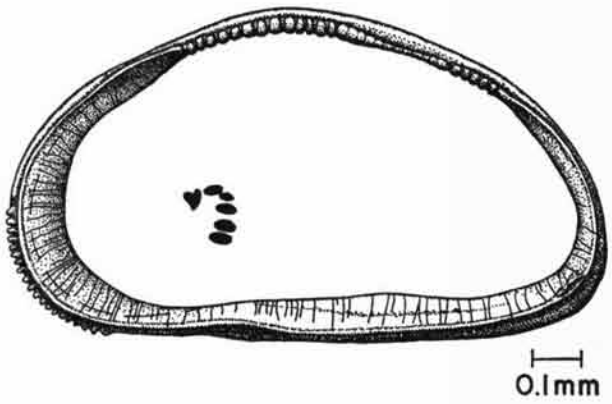


FIG. 14. *Haplocytheridea gigantea* BENSON & COLEMAN, n. sp. Interior view of the right valve of an adult specimen showing the characteristic holomerodont hinge and the small lenticular depression in the posteroventral section of the selvage.

lateral view; dorsal margin consisting of slightly curved anterior and posterior elements, which meet near center to form obtuse angle; venter sinuate, with very slight concavity in front of the center; anterior margin broadly rounded; posterior somewhat more narrowly rounded than anterior. Surface of valves covered with large elongate pits coincident with normal-pore canals, with long axes aligned roughly parallel to margins; interspaces very finely punctate.

Hinge of right valve consisting of anterior element bearing 12 or 13 teeth and posterior element of 5 or 6 teeth, connected by short crenulate bar; crenulations of bar tending to be poorly developed, giving appearance of smooth bar. Marginal area narrow centrally and posteriorly, moderately broad anteriorly; line of concrescence coinciding with inner margin throughout; selvage submarginal around free margin, with small lenticular cavity in posteroventral section. Muscle-scar pattern consisting of vertical row of 4 or 5 scars, with heart-shaped antennal scar in front of upper 2 and small circular mandibular scar near ventral margin. Radial-pore canals sinuate, irregularly spaced, somewhat more numerous anteriorly than posteriorly.

Dimensions. Length of adult specimen 1.23 mm; height 0.71 mm; width 0.60 mm.

Material. Specimens examined 356, of which 110 had both valves intact.

Remarks. Haplocytheridea gigantea differs from the following species, in that *H. montgomeryensis* (HOWE & CHAMBERS), 1935, is subpyriform rather than subovoid and is coarsely spinose over the entire anterior margin; *H. bassleri* STEPHENSON, 1943, has fewer teeth on the anterior hinge element and fewer denticles on the anteroventral margin; the posterior part of *H. ponderosa* (STEPHENSON), 1938, is higher and the anterior margin more narrowly rounded. None of these latter species has a depression in the posteroventral part of the selvage. Immature specimens, of which 151 were found, are not as elongate as adults but show all other features of the adults.

Occurrence. Living specimens found in the eastern Gulf of Mexico near the shore between latitudes 26° 20.6'N and 27° 43.8'N; extremely abundant at localities 12, 16, 17, 24, 25, 37, and 38. Depth range 20 to 63 feet, although most abundant at depths less than 35 feet; salinity range 35.61 to 37.41‰. Substrate predominantly medium-sized calcareous fragments.

HAPLOCYTHERIDEA PROBOSCIDIALA (Edwards), 1944

Pl. 3, Figs. 4-9; Fig. 15

Cytheridea (Haplocytheridea) proboscidiala EDWARDS, 1944, p. 508, pl. 85, figs. 8-11.

Haplocytheridea cf. *H. proboscidiala* (Edwards), PURI, 1953d, p. 234, pl. 2, figs. 17, 18, text-figs. 3e,f.

Diagnosis. Distinguished by its elongate-ovoid pitted carapace with reverse dentition, strong teeth occurring on left valve rather than on right.

EXPLANATION OF PLATE 3

BAIRDOPPILATA, HAPLOCYTHERIDEA

(All illustrated forms are from the eastern Gulf of Mexico, ×60)

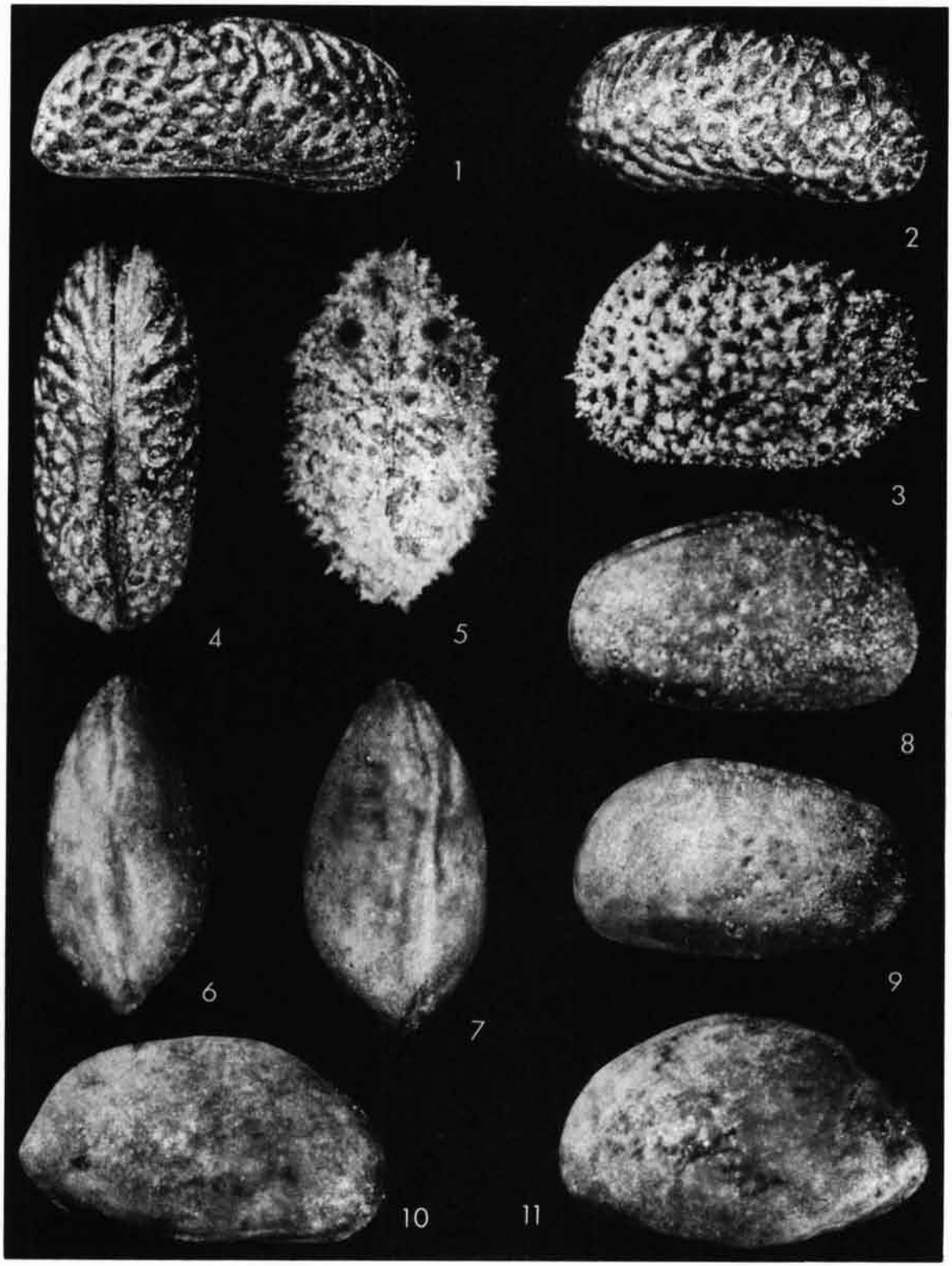
FIGURE — PAGE

1-3.—Bairdoppilata triangulata EDWARDS, 1944; *1*, exterior lateral view of right valve; *2*, exterior lateral view of left valve; *3*, dorsal view 20

4-9.—Haplocytheridea proboscidiala (EDWARDS), 1944; *4*, exterior lateral view of left valve of adult; *5*, exterior lateral view of right valve of adult; *6*, dorsal view of adult; *7*, dorsal view of immature specimen; *8*, exterior lateral view of left valve of an immature specimen; *9*, exterior lateral view of right valve of an immature specimen 28

10-14.—Haplocytheridea gigantea BENSON & COLEMAN, n.sp.; *10*, exterior lateral view of right valve of an immature specimen; *11*, exterior lateral view of left valve of an immature specimen, *12*, dorsal view of adult; *13*, exterior lateral view of right valve of adult; *14*, exterior lateral view of left valve of adult 27

BENSON & COLEMAN — Recent Marine Ostracodes, Eastern Gulf of Mexico



BENSON & COLEMAN — Recent Marine Ostracodes, Eastern Gulf of Mexico

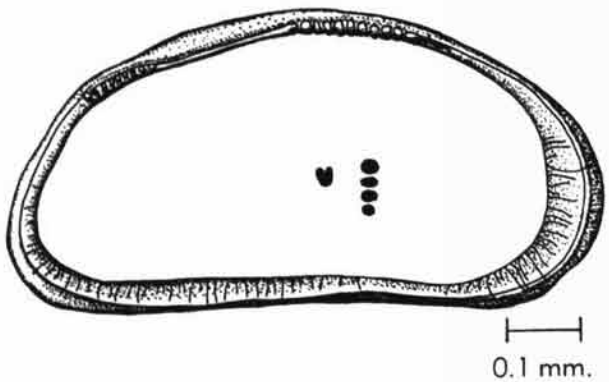


FIG. 15. *Haplocytheridea proboscidiala* (EDWARDS), 1944. Interior view of the left valve of an adult specimen showing the reversed hinge with the teeth in the left valve.

Dimensions. Length of adult specimen 0.81 mm; height 0.43 mm; width 0.34 mm.

Material. Specimens examined 298, of which 64 had both valves intact. Of these, 124 single valves and 3 complete carapaces were immature specimens.

Remarks. These specimens differ very slightly from those described by EDWARDS in that they are slightly smaller and do not show as marked a posteroventral swelling. *Haplocytheridea bradyi* (STEPHENSON), 1938, also exhibits reversed dentition, but the description and illustration of that species indicate a somewhat more delicate hinge. Immature specimens from the Gulf of Mexico are more triangular in lateral outline than are adults. Reversal of dentition and similar distribution indicate their relationship to adult specimens.

Occurrence. *Haplocytheridea proboscidiala* has been reported from the Miocene Duplin marl of North Carolina by EDWARDS (1944, p. 509), and questionably from the *Ecphora* and *Cancellaria* facies of the Choctawhatchee Stage of the Miocene of Florida (PURI, 1953d, p. 234). *H. bradyi* has been reported from the Pliocene Caloosahatchee marl of Florida (STEPHENSON, 1938, p. 132) and in Recent sediments of San Antonio Bay (SWAIN, 1955, p. 618). In the eastern Gulf of Mexico, *H. proboscidiala* was found in the shallower near-shore areas throughout the north-south extent of the area of investigation; abundant at localities 12, 15, 16, 18, and 36-38. Depth range 20 to 70 feet, although most abundant at depths of less than 35 feet; salinity range 34.86 to 37.79‰. Commonly associated with *Paracypris? sablensis,* often with *Paracytheridea tschoppi* and *Bairdia gerda.*

Subfamily CLITHROCYTHERIDEINAE Kollmann, 1958

[*nom. transl. et correct.* BENSON & COLEMAN, herein (*ex* Clithrocytherideini KOLLMANN, 1958), *non* MANDELSTAM, 1959].

Genus PERISSOCYTHERIDEA Stephenson, 1938

Perissocytheridea STEPHENSON, 1938, p. 144; SWAIN, 1955, p. 618; POKORNÝ, 1958, p. 246; HOWE, 1961, p. Q280.

Type-species. Cytheridea? matsoni STEPHENSON, 1935, p. 192, pl. 5, figs. 1, 2, 7, 8.

Diagnosis. Recognized by its smooth to reticulate, tumid, subpyriform carapace. Hinge antimerodont, in right valve consisting of elongate, crenulate, and elevated terminal teeth, separated by serrate groove. Marginal area fairly narrow, with vestibules developed anteriorly. Strong sexual dimorphism. *Mio.-Rec.; Brackish-water, shallow marine.*

PERISSOCYTHERIDEA LAEVIS Benson & Coleman, n.sp.

Pl. 4, Figs. 7, 10, 11; Fig. 16

Diagnosis. Distinguished by its smooth carapace and subdued ventrolateral inflation. *Rec.*

Description. Carapace moderately large, tumid, subpyriform, subovate in dorsal view except for pointed posterior extremity, without strong lateral extension in either sex: left valve larger than right. Highest anterior to mid-line, widest at center; subpyriform in lateral view, dorsal margin very slightly convex in front of and behind distinct obtuse angle at

EXPLANATION OF PLATE 4

HULINGSINA, ECHINOCYTHEREIS, CAMPYLOCYTHERE, PERISSOCYTHERIDEA

(All illustrated forms are from the eastern Gulf of Mexico)

FIGURE — PAGE

1-3.—Hulingsina ashermani (ULRICH & BASSLER), 1904; *1,* exterior lateral view of right valve; *2,* exterior lateral view of left valve; *3,* dorsal view; all ×65 30

4,5.—Echinocythereis garretti (HOWE & MCGUIRT), 1935; *4,* dorsal view; *5,* exterior lateral view of left valve, showing prominent eye tubercle; both ×65 46

6,8,9.—Campylocythere laevissima (EDWARDS), 1944; *6,* dorsal view; *8,* external lateral view of right side of whole carapace; *9,* external lateral view of left valve; all ×85 24

7,10,11.—Perissocytheridea laevis BENSON & COLEMAN, n.sp.; *7,* dorsal view; *10,* exterior lateral view of right valve; *11,* exterior lateral view of left valve; ×65 29

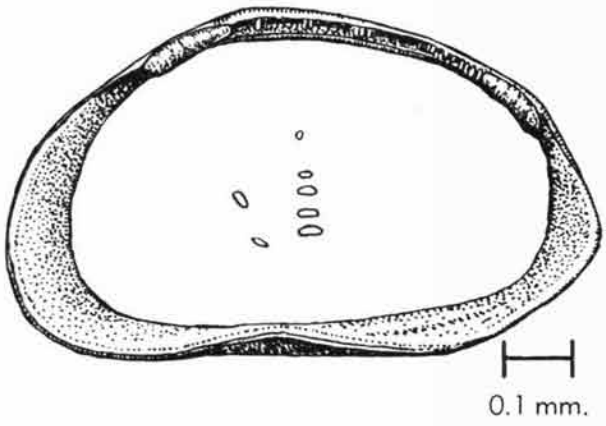


FIG. 16. *Perissocytheridea laevis* BENSON & COLEMAN, n. sp. Interior view of an adult right valve.

point of greatest height, venter convex, anterior margin broadly rounded, posterior produced into a rather sharp subventral caudal extension. Surface smooth, marked by irregularly arranged, fine normal-pore canals.

Hinge of right valve consisting of strong, crenulate, elevated terminal dental elements connected by crenulate groove. Marginal area moderately broad, narrow vestibule developed anteriorly. Muscle-scar pattern consisting of posterior vertical row of four scars with two scars in front.

Dimensions. Length of adult male specimen 0.91 mm; height 0.56 mm; width 0.47 mm. Length of female specimen 0.85 mm; height 0.54 mm; width 0.48 mm.

Material. Specimens examined 39, of which 2 had both valves intact.

Remarks. Sexual dimorphism occurs in this species, females being higher and more inflated with respect to length than males. This species differs from all previously described species of *Perissocytheridea* in having a smooth, rather than reticulate, surface.

The generic concept given by SWAIN (1955, p. 618) did not allow for a smooth form, but only pitted, ridged, or reticulate carapaces. *Perissocytheridea laevis* BENSON & COLEMAN, n. sp., is smooth and similar to other species classified as *Perissocytheridea* except for the absence of a well-defined sulcus, such as occurs in *P. brachyforma* SWAIN (1955, p. 620) or *P. rugata* SWAIN (1955, p. 622). KLIE (1939) described the genus *Ilyocythere* containing several species from the brackish-water environs of northeastern Brazil, including *I. gibba* and *I. cribrosa,* which have smooth carapaces. HOWE (1961, p. Q280) considered *Ilyocythere* as probably synonymous with *Perissocytheridea.*

Occurrence. Found in the eastern Gulf of Mexico from latitude 25° 32.1′N to the northern edge of the area of investigation, at localities 5, 17, 20, 21, 26, and 29-34. Depth range 24 to 239 feet, although most abundant at depths greater than 75 feet; salinity range 36.17 to 36.87‰. Commonly associated with *Echinocythereis garretti, Paracytheridea tschoppi,* and *Hulingsina ashermani.*

Subfamily NEOCYTHERIDEIDINAE Puri, 1957

Genus HULINGSINA Puri, 1958

Hulingsina PURI, 1958a, p. 173; HOWE, 1961, p. Q290.
Type-species. Hulingsina tuberculata PURI, 1953a, p. 173.

Diagnosis. Like *Cushmanidea* but with coarsely reticulate or pitted surface and very wide flange in posteroventer of right valve. *Mio.-Rec.*

HULINGSINA ASHERMANI (Ulrich & Bassler), 1904

Pl. 4, Figs. 1-3; Fig. 17

Cytherideis ashermani ULRICH & BASSLER, 1904, p. 126, pl. 37, figs. 10-16; HOWE AND OTHERS, 1935, p. 14, pl. 3, figs. 8-10; EDWARDS, 1944, p. 514, pl. 86, figs. 1-4; SWAIN, 1948, p. 195; ———, 1951, p. 19; PURI, 1952b, p. 910, pl. 130, figs. 4-8, text-figs. 1,2; ———, 1953d, p. 286, pl. 9, figs. 4-8; MALKIN, 1953, p. 778.

Cythereideis longula ULRICH & BASSLER, 1904, p. 128, pl. 37, figs. 21-27; SWAIN, 1948, p. 195; ———, 1951, p. 19.

Cytherideis agricola Howe & Hadley, MALKIN, 1953, p. 779-780, pl. 28, figs. 24, 25.

Cytherideis semicircularis ULRICH & BASSLER, 1904, p. 127, pl. 37, figs. 18-20.

Cushmanidea ashermani (Ulrich & Bassler), MCLEAN, 1957, p. 77, pl. 8, fig. 5a-f.

Hulingsina ashermani (Ulrich & Bassler), PURI, 1958a, p. 173.

Hulingsina sulcata PURI, 1960, p. 118, pl. 2, figs. 6, 7, text-figs. 43-46.

Diagnosis. Distinguished by its deeply pitted carapace, with arched dorsal margin. Selvage of right valve quite distinct, high and sharp, submarginal near midventer, swinging upward in front of posterior margin, leaving broad flat flange bounded by narrowly rounded posteroventral extension. *Mio.-Rec.*

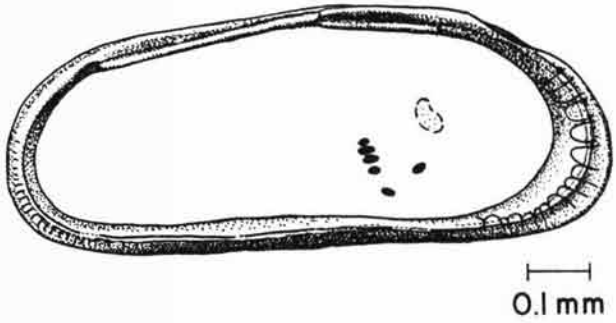


FIG. 17. *Hulingsina ashermani* (ULRICH & BASSLER), 1904. Interior view of the left valve of an adult specimen.

Dimensions. Length of adult specimen 0.92 mm; height 0.43 mm; width 0.39 mm.

Material. Specimens examined 311, of which 53 had both valves intact.

Remarks. Specimens from the Gulf of Mexico have a somewhat wider, flat posteroventral flange than most specimens reported from Miocene sediments, but other characteristics are identical.

Hulingsina sulcata PURI was described by PURI (1960, p. 119) as like *H. ashermani* ". . . in general outline and reticulate pattern of the carapace . . ." distinguishable ". . . from it [*H. ashermani*] by its [*H. sulcata*] well developed sulcus." After examination of specimens from the Chipola Formation (Miocene) of Florida identified by PURI (1953, p. 286) as *H. ashermani* and specimens of the same species from the Yorktown Formation (Miocene) of Virginia, we conclude that most specimens of *H. ashermani* have a sulcus. Some of the Miocene specimens have a much more pronounced sulcus than Recent forms from Florida. It seems that rather than erecting a new species, the description of the old one should be broadened, unless other differences become known.

Occurrence. Reported previously only from Miocene sediments, from Maryland by ULRICH & BASSLER (1904, p. 126), SWAIN (1948, p. 195), and MALKIN (1953, p. 778); from the Duplin marl of North Carolina by EDWARDS (1944, p. 514); from Guatemala by VAN DEN BOLD (1946, p. 87); and from all facies except the Hawthorn of the Alum Bluff and Choctawhatchee Stages of Florida by PURI (1952b, p. 910; 1953d, p. 287). Found in the northern part of the study area in the eastern Gulf of Mexico from latitude 25° 29.0'N to the northern edge of the area of investigation; abundant at localities 8, 15, 17, 18, 20, 21, 27, 29-34. Depth range 32 to 239 feet, although most abundant at depths greater than 60 feet; salinity range 35.01 to 37.39‰. Commonly associated with *Paracytheridea tschoppi* and *Echinocythereis garretti.*

Family CYTHERURIDAE Müller, 1894

Genus CYTHERURA Sars, 1866

Cytherura SARS, 1866, p. 60; MÜLLER, 1894, p. 286; ALEXANDER, 1936, p. 690; EDWARDS, 1944, p. 525; STEPHENSON, 1946, p. 316; HORNIBROOK, 1952, p. 50; SWAIN, 1955, p. 626; KEIJ, 1957, p. 144; HANAI, 1957, p. 16; BENSON, 1959, p. 51; POKORNÝ, 1958, p. 285; REYMENT, 1961, p. Q291.

Type-species. Cythere gibba O. F. MÜLLER, 1785, p. 66, pl. 7, figs. 7-9 [subsequent designation BRADY & NORMAN, 1889].

Diagnosis. Recognized by its small, usually fragile carapace, with broadly rounded anterior and dorsally caudate posterior regions. In dorsal view valves tapering forward, mucronate in front, acuminate behind. Surface usually irregularly ribbed or reticulate, with small eye tubercles. Marginal area narrow as compared to *Semicytherura,* few radial-pore canals. Hinge modified merodont, in right valve consisting of elongate crenulate terminal teeth formed from extensions of selvage, separated by intermediate groove that may be open ventrally. Sexual dimorphism strong. *Cret.-Rec.*

Ecology. This genus has been reported from brackish to normal marine waters, from the intertidal zone to depths of 150 fathoms.

CYTHERURA JOHNSONI Mincher, 1941

Pl. 6, Figs. 1-5; Fig. 18

Cytherura johnsoni MINCHER, 1941, p. 343, pl. 47, figs. 1a-d; SWAIN, 1955, p. 627, pl. 64, figs. 8a-c, text-figs. 35b and 38, 8a,b and 39, 1a-c; PURI & HULINGS, 1957, p. 174, 176, 183, 188; PURI, 1960, p. 114, pl. 4, figs. 14, 15.

Cytherura forulata EDWARDS, 1944, p. 526, pl. 88, figs. 17-20; MALKIN, 1953, p. 789; SWAIN, 1955, p. 628, pl. 64, figs. 10a-c, text-figs. 35c and 39, 2a,b; PURI & HULINGS, 1957, p. 176, 183; PURI, 1960, p. 115, pl. 4, figs. 16, 17.

Cytherura elongata EDWARDS, 1944, p. 526, pl. 88, figs. 21-25; SWAIN, 1955, p. 628, pl. 64, figs. 12a,b.

Diagnosis. Distinguished by its straight to slightly curved dorsal margin and short, blunt caudal extension dorsal to midline. Ornamentation consisting of approximately 10 longitudinal ribs converging anteroventrally, with smaller reticulating cross-ribs between. *Mio.-Rec.*

Description. Carapace medium-sized, ovoid to subquadrate, subovate in dorsal view; left valve slightly larger than right, overreaching around free margin, highest and widest posterior to midline, subovate in lateral view; dorsal margin of left valve straight, of right valve slightly arched; venter of left valve straight, of right valve slightly sinuate; anterior margin broadly rounded; posterior end produced into short, blunt caudal extension dorsal to midline. Surface of valves marked by about 10 bold longitudinal ribs, which originate behind area of maximum width and converge toward anteroventral margin; short transverse ridges between longitudinal ribs producing subreticulate pattern. Ventral margin in some forms hidden by subventral inflation of valves.

Hinge of right valve an extension of selvage, consisting of anterior trilobate tooth and posterior bladelike tooth connected by groove, at each end of which is a narrow elongate socket; hinge of left valve consisting of terminal sockets connected by a bar, each end of which is developed into an elongate, lobate toothlet. Line of concrescence coinciding with inner margin except anteriorly, where narrow vestibule is developed. Marginal area moderate in width. Radial-pore

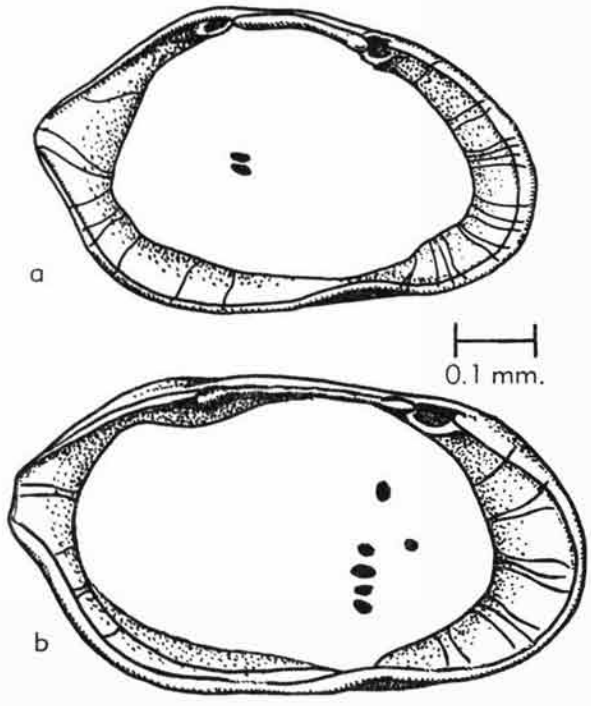


FIG. 18. *Cytherura johnsoni* MINCHER, 1941; two variants of what are believed to be the same species.—*a*. Interior view of the left valve of an adult female(?).—*b*. Interior view of the left valve of an elongate adult male(?).

canals long, slightly curved. Muscle-scar pattern typical of genus.

Dimensions. Length of adult male specimen 0.63 mm; height 0.35 mm; width 0.30 mm.

Material. Specimens examined 146, of which 36 had both valves intact. Of these, 123 of the total number and 22 of the complete specimens were adults.

Remarks. The specimens of *Cytherura* described here show intergradations of characters used in the definition of three previously described species: *C. johnsoni* MINCHER, 1941; *C. forulata* EDWARDS, 1944; and *C. elongata* EDWARDS, 1944. MALKIN (1953, p. 789) noted that *C. forulata* and *C. elongata* are quite possibly conspecific; her theory is supported by evidence supplied by our specimens from the eastern Gulf of Mexico. Smaller, more nearly ovoid specimens were found at the same localities as larger, subquadrate individuals and are probably immature forms.

This species or series of species is poorly understood by us, as available comparative material is poorly preserved, and there seems to be intergradation between forms described by others in past studies. SWAIN (1955, p. 627) distinguished specimens which he identified as *C. johnsoni* on the basis of their blunt caudal process and dominance of longitudinal elements over the transverse cross-bars in the reticulate surface pattern; he identified *C. elongata,* with difficulty, by its elongate shape (he seemed unsure about dimorphic characters); and he distinguished *C. forulata* from *C. elongata* by the absence of a caudal process and the more convex dorsum of the latter. We found what we believe to be intergradation of all of these characters.

Occurrence. Cytherura johnsoni was originally described by MINCHER (1941, p. 343) from the Miocene Pascagoula Formation of Louisiana, later reported by SWAIN (1955, p. 626) from San Antonio Bay and by PURI & HULINGS (1957, p. 176, 183, 188) from Recent sediments of the Panama City and Alligator Harbor areas of the Gulf of Mexico and from Florida Bay. *C. forulata* and *C. elongata* were described by EDWARDS (1944, p. 526) from the Miocene Duplin Marl and reported by SWAIN (1955, p. 628) from San Antonio Bay. *C. forulata* has been additionally reported by MALKIN (1953, p. 789) from the upper Yorktown Formation of the Miocene of Maryland and Virginia, and by PURI & HULINGS (1957, p. 176, 183) and PURI (1960, p. 114) from Recent sediments of the Panama City and Alligator Harbor areas of the Gulf of Mexico. Found in the eastern Gulf of Mexico throughout the north-south extent of the area of investigation; abundant at localities 2-5, 15-18, 20, 21, 29, and 30. Depth range 19 to 131 feet; salinity range 36.17 to 39.92‰. Commonly associated with *Paracytheridea tschoppi, Aurila conradi floridana,* and *Hulingsina ashermani.*

Genus HEMICYTHERURA Elofson, 1941

Hemicytherura ELOFSON, 1941, p. 314; HORNIBROOK, 1952, p. 58; WAGNER, 1957, p. 75; HANAI, 1957, p. 23; BENSON, 1959, p. 52; POKORNÝ, 1958, p. 286; REYMENT, 1961, p. Q293.

Type-species. Cythere cellulosa NORMAN, 1865, p. 22, pl. 5, figs. 17, 20, pl. 6, fig. 17.

Diagnosis. Recognized by its small, very strong, coarsely ridged, subquadrate carapace, with distinct subdorsal caudal process. Hinge of right valve consisting of small terminal teeth, formed from extensions of selvage, separated by groove that is open to interior of valve. Hinge overlain by flange and flange groove. Duplicature wide but not deltaic; small vestibules may be developed anteriorly and posteriorly. Radial-pore canals long, curved, grouped anteriorly. Muscle-scar pattern consisting of vertical row of four, with one anterior. *Plio.-Rec.*

Ecology. Believed to be confined to normal marine salinities, but reported from intertidal zone to depths of 150 fathoms.

HEMICYTHERURA SABLENSIS Benson & Coleman, n.sp.

Pl. 6, Figs. 6, 8; Fig. 19

Diagnosis. Distinguished by its strong, sharp longitudinal ridges, with few transverse ridges, and its subquadrate shape. *Rec.*

Description. Carapace small, subquadrate, very strong, subspatulate in dorsal view, dorsal and ventral margins parallel, widest posterior to midline, subquadrate in lateral view; dorsal margin straight between cardinal angles; venter slightly convex; anterior margin smoothly and broadly rounded; posterior extremity produced into prominent caudal

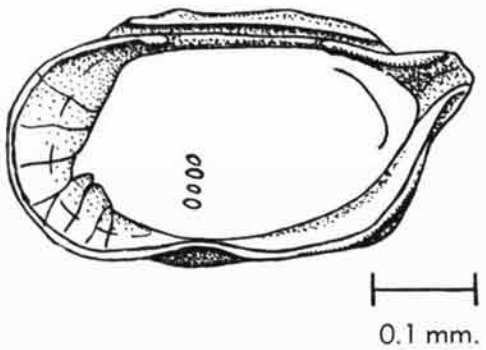


FIG. 19. *Hemicytherura sablensis* BENSON & COLEMAN, n. sp.—*a.* Interior view of the right valve of an adult specimen.

process just beneath dorsal margin, obliquely rounded below and above this extension. Surface very coarsely sculptured, marked by 4 long and 1 or 2 shorter strong longitudinal ridges, ventral ridge overhanging ventral margin; several faint transverse ridges present, most conspicuous of which connects upper 3 longitudinal ridges near posterior margin.

Hinge typical of genus; anterior tooth of right valve simple, bladelike. Line of concrescence coinciding with inner margin and quite irregular. Marginal area moderately broad posteriorly and ventrally, very broad anteriorly. Simple curved radial-pore canals occurring in groups anteriorly, not observed posteriorly.

Dimensions. Length of adult specimen 0.44 mm; height 0.24 mm; width 0.24 mm.

Material. Specimens examined 25, of which 7 had both valves intact.

Remarks. Hemicytherura cellulosa (NORMAN), the type-species, has a much more highly arched dorsum and is reticulate. No other species of the genus has such pronounced longitudinal ridges with faint transverse ridges. *H. cranekeyensis* PURI (1960, p. 115), described from Tampa Bay and Florida Bay, is spatulate in lateral view as compared to the subquadrate shape of *H. sablensis;* it is described from an area within a few miles of the type locality of *H. cranekeyensis.* Both species appear to be distinct and discrete; the longitudinal ridges are dominant in the appearance of *sablensis,* and the pits or openings between the transverse and longitudinal ridges of nearly equal thickness are dominant in *cranekeyensis.*

Occurrence. Found in the eastern Gulf of Mexico throughout the north-south extent of the area of investigation, but much more abundant south of latitude 25° 32.1′N; generally rare but most abundant at locality 3, found also at localities 1, 2, and 5. Depth range 19 to 27 feet; salinity range 37.27 to 39.92‰. Associated with *Loxocorniculum postdorsolatum* and *Aurila conradi floridana.*

Genus PARACYTHERIDEA Müller, 1894

Paracytheridea MÜLLER, 1894, p. 340; VAN DEN BOLD, 1946, p. 26; POKORNÝ, 1958, p. 252; BENSON, 1959, p. 49; REYMENT, 1961, p. Q299 (*non* PURI, 1957, p. 191).

Type-species. Paracytheridea depressa MÜLLER, 1894, p. 341, pl. 26, figs. 16-26, pl. 29, figs. 4-8 [=*Cytheropteron bovettensis* SEGUENZA, 1880, p. 65, pl. 17, fig. 54].

Diagnosis. Recognized by its elongate subrectangular carapace, dorsal caudal extensions, posteroventral alar extension, and merodont hinge. *?Penn., U.Cret.-Rec.*

Ecology. Little is known of the ecology of this genus. One shallow-water marine species was found by BENSON (1959, p. 49) from Baja California. Two species doubtfully belonging to *Paracytheridea* were found by SWAIN (1955, p. 623) and CURTIS (1960, p. 478) living in brackish water. The present form is inner neritic.

PARACYTHERIDEA TSCHOPPI van den Bold, 1946

Pl. 6, Figs. 7, 9, 10; Fig. 20

Paracytheridea tschoppi VAN DEN BOLD, 1946, p. 85, pl. 16, fig. 6, 7; KRUIT and KEY, *in* VAN ANDEL & POSTMA, 1954, p. 220, pl. 4, fig. 4; VAN DEN BOLD, 1957, p. 245, pl. 4, fig. 7.

Description. VAN DEN BOLD's original description included such characters as: long and pointed subdorsal caudal process; swelling in muscle-scar region and posterodorsum; strong ala; downward-projecting spine halfway between ala and subdorsal caudal process; several anterior ridges that tend to radiate from subcentral swelling with horizontal ridge most prominent; three peaks on dorsal boss of left valve.

Our observations agree with the later illustration of VAN DEN BOLD (1957, pl. 4, fig. 7) and the following description of surface ornamentation can be added.

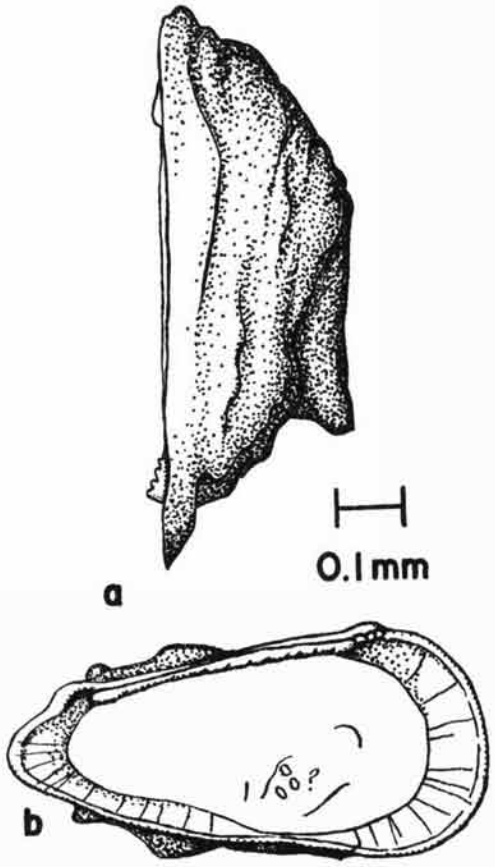


FIG. 20. *Paracytheridea tschoppi* VAN DEN BOLD, 1946.—*a*. Generalized dorsal view of the right valve of an adult specimen.—*b*. Interior view of the left valve of an adult specimen.

Thin knife edge of ala merges with anterior region and continues into posterior region; a ridge runs ventrally from area of the eye to intersect the main horizontal anterior ridge; ridges emanating from anterior region, venter, and posterodorsum intersect in a loop in subcentral swelling; two prominent ridges run up over the posterodorsal swelling toward the subcentral swelling, the lower one intersecting the loop and the upper ridge merging with the carapace; several small nodes or "peaks" present in the posterior region midway between the dorsal and ventral part of the caudal extension. From this ridged variant of the species, the ornament grades in the population toward suppression of the individual ridges by filling in of secondary cross-ridges to form a variant with a reticulate carapace.

Dimensions. An extreme degree of variability exists within this species, so that it is not practical to give even a meaningful average size. The caudal extension and the alae of some forms become very elongate, whereas others remain short and many are broken. The longest valve found was a left valve measuring 0.76 mm in length, 0.35 mm in height. The highest valve found was a right valve measuring 0.71 mm in length, 0.38 mm in height. Specimens with similar degrees of variation were found at almost every station. The only complete carapace, an immature individual, measured 0.45 mm in length, 0.30 mm in height, and 0.42 mm in width. The type of *Paracytheridea tschoppi* is 0.53 mm in length. After examining the illustration given by VAN DEN BOLD (1946, p. 85, pl. 16, fig. 6, 7) we suggest that the type-specimen of this species is a late instar. As the late immature stages of *Paracytheridea* also have merodont hinges, the adults are sometimes difficult to determine by any other criteria than size.

Material. Specimens examined 254, only one of which had both valves intact.

Remarks. This species is quite variable in size and shape, as well as in surface ornament. Some specimens are much more elongate than others; others have developed very long, pronounced alae and caudal extensions; some are more reticulate than others; on some the alae seem to be directed more ventrally than in others; some fail to show much development of the posteroventral node, while others have a highly tumid node. Any and sometimes all of these variations may occur at a single locality, tending to eliminate the possibility that they represent subspecific differences.

Occurrence. Previously reported from Recent sediments by KRUIT and KEY, *in* VAN ANDEL & POSTMA (1954) from the seas around Trinidad. Also reported from the Miocene of the Caribbean area (VAN DEN BOLD, 1946, p. 8; 1957, p. 245). Found in the eastern Gulf of Mexico throughout the north-south extent of the area of investigation; abundant at localities 1, 2, 4, 15-18, 20, 21, 29, 30, 33, 34, and 38. Depth range 19 to 131 feet; salinity range 35.61 to 39.41‰. Two other species of *Paracytheridea* have been reported from the Recent of the Gulf of Mexico, *P. troglodyta* by SWAIN (1955) and CURTIS (1960), which doubtfully belongs to this genus, and *P. washingtonensis* by PURI (1960), which is not alate nor does it have the pronounced extension of *P. tschoppi*.

Family HEMICYTHERIDAE Puri, 1953

Genus AURILA Pokorný, 1955

Aurila POKORNÝ, 1955, p. 17; HOWE, 1961, p. Q302 (*non* POKORNÝ, 1958, p. 268).

Type-species. Cythere convexa BAIRD, 1850.

Diagnosis. Distinguished from other almond-shaped hemicytherids by its massive carapace and rela-

tively short holamphidont hinge consisting of high narrowly stepped anterior tooth in right valve with reniform, ventrally incised posterior tooth. *Mio.-Rec.; Marine.*

AURILA CONRADI (Howe & McGuirt, 1935) FLORIDANA Benson & Coleman, n. subsp.

Pl. 8, Figs. 10-12; Fig. 21

Hemicythere conradi Howe and McGuirt, SWAIN, 1955, p. 635, pl. 62, fig. 3a-c; PURI & HULINGS, 1957, p. 174, 183, 188.

Aurila conradi (Howe & McGuirt), PURI, 1960, p. 129, pl. 3, figs. 9, 10.

Hemicythere cf. *H. cymba* (Brady), CURTIS, 1960, p. 484, pl. 3, fig. 11.

Diagnosis. Distinguished from *Aurila conradi conradi* by its thinner, deeper, more delicate reticulate surface, with polygonal depressions; thin, wider, somewhat fluted ventrolateral keel; continued development of reticulation across subcentral region; and vertical ribs reinforcing flange above hinge.

Description. Carapace almond-shaped; moderately robust. Highest and widest near median line; inflated in dorsal view, with flaring anterior rims; in lateral view, high broadly rounded dorsum, oblique well-rounded anterior end with suggestion of produced lip, straight to slightly sinuate venter, with sinuation near anterior margin; posterior extremely caudate, blunt.

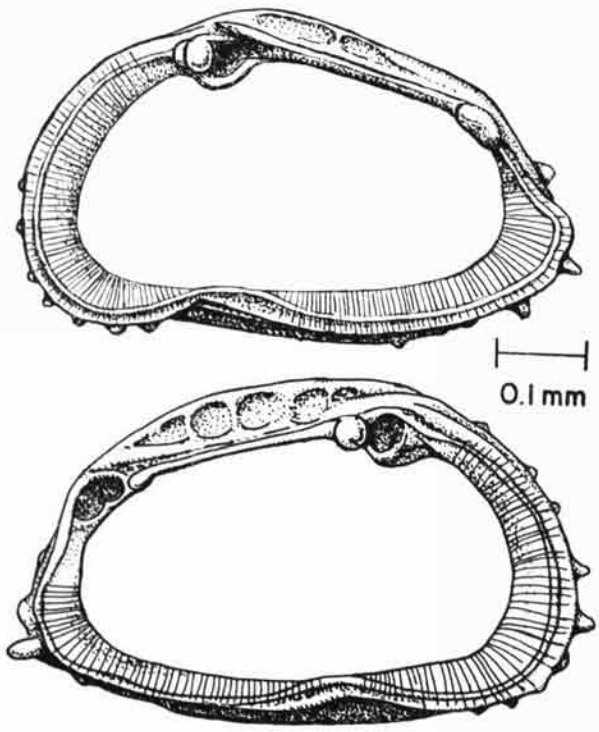


FIG. 21. *Aurila conradi* (HOWE & MCGUIRT) *floridana* BENSON & COLEMAN, n. subsp.—*a.* Interior view of the right valve of an adult specimen showing a typical auriliid hinge.—*b.* Interior view of the left valve of an adult specimen showing the hinge and the overlying flange with vertical ribbing, and the marginal area.

Surface reticulate, with high, fine, delicate ridges and polygonal depressions; anterior ridge subparallel to anterior margin; thin, wide, somewhat fluted ventrolateral ridge; posterodorsal ridge; subdued dorsal ridge extending from under eye tubercle to posterodorsum.

Interior with holamphidont hinge; anterior tooth of right valve with narrow step, posterior tooth reniform, with ventral sulcus; posterior socket in left valve reflecting reniform tooth of right valve, with ventral node; broad flange above hinge of left valve reinforced by vertical ribs. Marginal area and muscle-scar pattern typical for genus.

Dimensions. Length of adult specimen 0.63 mm; height 0.40 mm; width 0.36 mm.

Material. Specimens examined 202, of which 51 had both valves intact.

Remarks. Individual depressions of the surface of *Aurila conradi floridana* match those of *A. conradi conradi* in location but not in degree of development. Those of *A. conradi conradi* are more robust, with thicker confining ridges, and they are rounded instead of well defined and polygonal. The subcentral region of the surface in the area of the adductor muscle scars is thickened and smooth, with a few punctae in *A. conradi conradi,* but the open reticulations of *A. conradi floridana* continue to the rest of the carapace. The caudal extension of *A. conradi conradi* is blunt and generally rounded, whereas that of *A. conradi floridana* is more angular and possesses two to three spines. The hinge flange in the left valve of *A. conradi conradi* is a low smooth ridge separated from the hinge bar by a smooth shallow groove; that of *A. conradi floridana* is a high ridge separated from the hinge bar by a broad flat area crossed by vertical ribs.

The specimens identified as *Hemicythere conradi* by SWAIN (1955) and those of *H.* cf. *H. cymba* by CURTIS (1960) undoubtedly belong to this subspecies. Those identified by PURI (1960) as *Aurila conradi* and *Hemicythere cymba* are in doubt, as no judgment could be made from his illustrations. Much of PURI's material was collected from the edges of the area of the present study, and it is probable that we have the same form.

Occurrence. Reported by SWAIN (1955, p. 635) from San Antonio Bay and by CURTIS (1960, p. 484)

from the Mississippi Delta region. Its distribution is believed to be the shallow marine and coastal waters of the northern and eastern Gulf of Mexico. Found by the present study in the eastern Gulf of Mexico along the Florida Coast from Tampa to Florida Bay at localities 3-5, 8, 20, 29, 30, 36, and 37. Depth range 19 to 131 feet; salinity 36.17 to 39.92‰.

AURILA AMYGDALA (Stephenson), 1944, Benson & Coleman (n. comb.)

Pl. 8, Figs. 6, 8, 9; Fig. 22

Hemicythere amygdala STEPHENSON, 1944a, p. 158, pl. 28, figs. 8, 9; PURI, 1953b, p. 176, pl. 1, fig. 3; ———, 1953d, p. 266, pl. 11, fig. 14; PURI & HULINGS, 1957, p. 174; PURI, 1960, p. 129, text-figs. 31, 32.

Diagnosis. Distinguished by its small, almond-shaped carapace, ornamented by concentric pattern of pits, which are individually circular near centers of valves, elongate but not reticulate near margins; evenly rounded anterior and a blunt posterior.

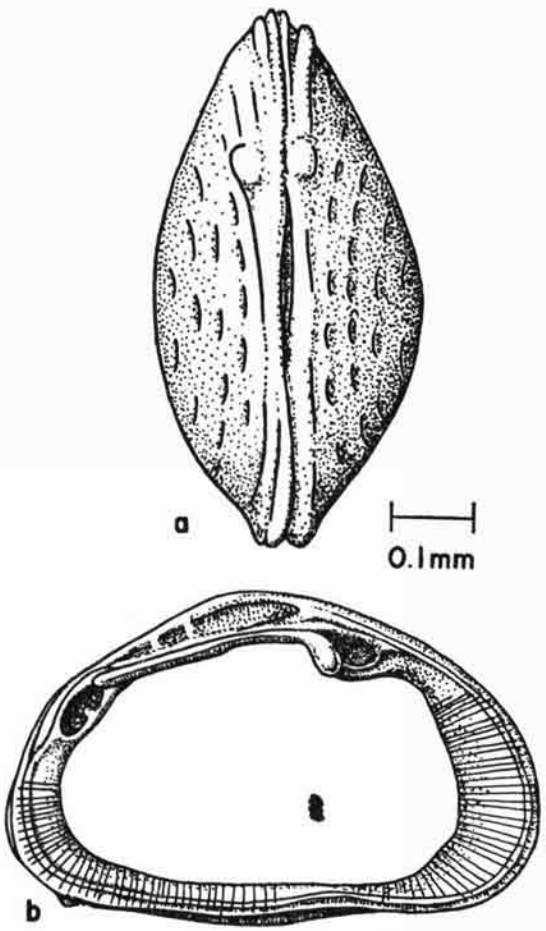


FIG. 22. *Aurila amygdala* (STEPHENSON), 1944.—*a.* Dorsal view of a complete specimen.—*b.* Interior view of the left valve of an adult specimen showing a well developed auriliid hinge.

Dimensions. Length of adult specimen 0.59 mm; height 0.36 mm; width 0.28 mm.

Material. Specimens examined 15, of which 12 had both valves intact.

Remarks. This species greatly resembles *Hemicythere laevicula* EDWARDS, 1944, but differs in having stronger surface pitting and a more advanced hinge. The specimens from the Gulf of Mexico have a single denticle near the posteroventral corner of the carapace. This species has been transferred to the genus *Aurila* POKORNÝ because it has a much more advanced hinge than the typical hemicytherid.

Occurrence. Reported from Recent sediments, but no location given, by PURI & HULINGS (1957, p. 174); PURI (1960, p. 129) reported finding this species in Tampa Bay. Originally described by STEPHENSON (1944, p. 158) from the subsurface Oligocene *Discorbis, Heterostegina,* and *Marginulina* zones of the Gulf coastal area of Texas. Reported by PURI (1953b, p. 176; 1953d, p. 266) from the Chipola, Oak Grove, and Shoal River facies of the Alum Bluff Stage of the Miocene of Florida. Found in the eastern Gulf of Mexico from latitude 24° 59.0'N to the northern edge of the area of investigation; at localities 2-4, 15, 27, 29, 35, and 37. Depth range 19 to 76 feet; salinity 36.91 to 39.92‰.

Family LOXOCONCHIDAE Sars, 1925

Genus LOXOCONCHA Sars, 1866

Loxoconcha SARS, 1866, p. 61; ———, 1926, p. 217; ALEXANDER, 1936, p. 693; MURRAY, 1938, p. 586; EDWARDS, 1944, p. 526; KEIJ, 1957, p. 139; BENSON, 1959, p. 51; POKORNÝ, 1958, p. 292; HOWE, 1961, p. Q312.

Loxoleberis SARS, 1866, p. 130 [by HOWE, 1955, and 1961, p. Q313.]

Normania BRADY, 1866, p. 832 (*non* BOWERBANK, 1869; *nec* BOECK, 1871) [see HOWE, 1961, p. Q313; 1962, p. 156].

Type-species. Cythere impressa BAIRD, 1850 (*non* M'COY, 1844) (=*Cythere rhomboidea* FISCHER, 1855=*Loxoconcha bairdii* MÜLLER, 1894).

Diagnosis. Recognized by its rhomboidal to ovoid carapace; venter broadly rounded, commonly sinuate; dorsum straight to slightly arched. Surface of valves pitted, reticulate, or smooth. Hinge gongylodont; right valve with anterior rounded tooth with groove curving around it, straight serrate median groove, and posterior crescentic tooth enclosing smooth socket. Marginal area moderately broad; narrow vestibules anterior and posterior. Radial-pore canals moderately numerous, straight, simple. Muscle-scar pattern consisting of vertical row of four scars, with single reniform antennal scar. Sexual dimorphism pronounced, males more elongate than females. *Cret.-Rec.*

LOXOCONCHA SARASOTANA Benson & Coleman, n.sp.

Pl. 7, Figs. 7-10; Fig. 23a

Diagnosis. Distinguished by its subovate lateral outline, with indistinct cardinal angles, subreticulate surface, and sharp ridge that runs parallel to posterior and ventral margins. *Recent.*

Description. Carapace medium-sized, subovoid, subovate in dorsal view, highest and widest posterior to center, subovate in lateral view; dorsal margin slightly arched on females, straight on males, with very indistinct cardinal angles; venter straight to very slightly convex; anterior margin broadly rounded below, obliquely rounded above, merging imperceptibly with dorsal margin; posterior margin obliquely rounded below, obliquely truncate above, with narrowly rounded subdorsal caudal extension, dorsal and ventral margins of males converging anteriorly. Surface subreticulate; sharp dorsal marginal ridge extending from caudal extension to about mid-point of anterior margin; second well-defined, sharp ridge arising beneath posterior cardinal angle, extending approximately parallel to posterior margin, swinging close to center of ventral margin, then curving slightly upward and disappearing at point beneath anterior cardinal angle; surface of carapace coarsely reticulate, between this ridge and dorsal and anterior margins pattern of reticulation being parallel to dorsal margin and subventral ridge.

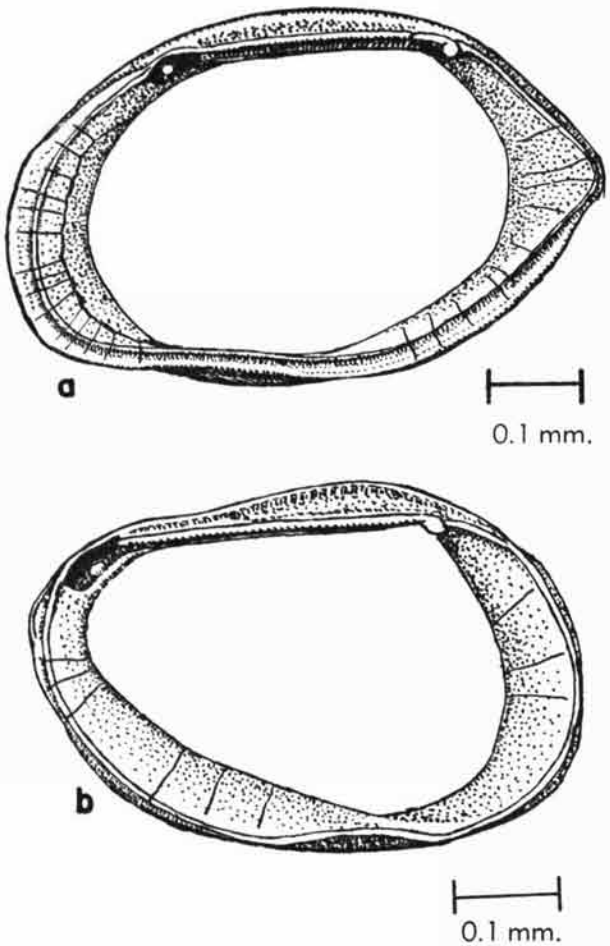


FIG. 23. *Loxoconcha sarasotana* BENSON & COLEMAN, n.sp. —*a*. Interior view of an adult right valve. *Loxoconcha* sp. aff. *L. australis* BRADY, 1880.—*b*. Interior view of an adult left valve.

Hinge typical of genus. Marginal area moderately broad. Line of concrescene coinciding with inner margin except anteriorly, where narrow vestibule is developed. Muscle-scar pattern obscured by ornamentation. Radial-pore canals few, straight, simple.

Dimensions. Length of adult female specimen 0.66 mm; height 0.42 mm; width 0.34 mm. Length of adult male right valve 0.68 mm; height 0.41 mm. Length of immature complete male specimen 0.62 mm; height 0.38 mm; width 0.28 mm.

Material. Specimens examined 66, of which 20 had both valves intact.

Remarks. Loxoconcha impressa (BAIRD), 1850, the type-species, is much more arched dorsally than *L. sarasotana* and lacks ridges on the carapace. The very strong subventral ridge distinguishes the new species from all others of the genus.

Occurrence. Found in the eastern Gulf of Mexico from latitude 26° 13.3′N to the northern edge of the area of investigation; very abundant at locality 36, moderately abundant at localities 17 and 37. Complete specimens also found at localities 11, 15, and 18. Depth range 20 to 63 feet, but most abundant between 30 and 50 feet; salinity range 36.23 to 37.84‰.

LOXOCONCHA sp. aff. L. AUSTRALIS Brady, 1880

Pl. 7, Figs. 5, 6; Fig. 23b

Loxoconcha australis BRADY, 1880, p. 119, pl. 29, fig. 5a-f, pl. 29, fig. 3a-d; SWAIN, 1955, p. 630, pl. 63, fig. 11, pl. 64, fig. 2; PURI & HULINGS, 1957, p. 187, fig. 11; CURTIS, 1960, pl. 2, figs. 12, 15; PURI, 1960, p. 111, text-fig. 33, 34, 38.

Diagnosis. Distinguished by its very tumid ovoid carapace, ornamented by coarse pits arranged concentrically about center of valve, ventral surface grooved longitudinally; no caudal extension; posterior extremity located just below dorsal margin.

Description. Carapace small, thick, tumid, subovoid, subovate in dorsal view, highest anterior to center, widest at center, ovate in lateral view; dorsal

margin very slightly sinuous, concave posteriorly, convex anteriorly; venter slightly convex; anterior margin broadly rounded; posterior margin obliquely rounded below, obliquely truncate above, with posterior extremity above mid-line. Surface covered with large subcircular pits arranged concentrically about center of valve; indistinct grooves rising beneath posterior cardinal angle, extending approximately parallel to posterior and ventral margins, disappearing in front of mid-line. Hinge and muscle-scar pattern typical of genus. Marginal area broad, with narrow vestibules developed anteriorly and posteriorly. Radial-pore canals not observed.

Dimensions. Length of adult specimen 0.52 mm; height 0.36 mm; width 0.30 mm.

Material. Specimens examined 20, of which 10 had both valves intact.

Remarks. This species is similar to *Loxoconcha australis* BRADY, 1880, major differences being the posterior convergence of the dorsal and ventral margins and the subdorsal position of the posterior extremity of the present form. The type-species, *L. impressa* (BAIRD), 1850, has a more produced and oblique anterior region and a more rounded, less caudate, posterodorsum. The form called *L. australis* by CURTIS (1960, pl. 2, fig. 12) is more boldly ridged along the venter than the form here described. The outline is doubtfully that of *L. australis* as figured by BRADY (1880, pl. 28, fig. 5; pl. 29, fig. 3) but is certainly closely related. The form illustrated by SWAIN (1955, pl. 63, fig. 11; pl. 64, fig. 2) is identical with that described in this report; however, SWAIN's specimens can be only loosely identified as belonging to BRADY's species.

Occurrence. Found in the eastern Gulf of Mexico in the northern part of the study area from latitude 25° 29.0'N to the northern edge of the area of investigation, at localities 8, 20, 21, 27, 29, 30, and 42. Depth range 66 to 95 feet; salinity range 36.0 to 37.9‰. Commonly associated with *Bairdia victrix, Paracytheridea tschoppi, Aurila conradi floridana,* and *Echinocythereis garretti.*

Genus LOXOCORNICULUM Benson & Coleman, n. gen.

Type-species. Cythere fischeri BRADY, 1869, p. 154, pl. 18, figs. 15, 16.

Diagnosis. Loxoconchid in shape; moderately to coarsely reticulate with hornlike protuberance on posterodorsum; hinge gongylodont. *?Olig.,Mio.-Rec.; Marine.*

Remarks. A member of the family Loxoconchidae SARS, 1925, *Loxocorniculum* can be distinguished from other related genera having species with a gongylodont hinge by its reticulate surface and posterodorsal protuberance. Species other than *L. fischeri* (BRADY), for which this genus is being erected, include *L. anderseni* (PURI), 1953, *L. rugosa* (VAN DEN BOLD), 1946, *L. postdorsolatum* (PURI), 1960, and possibly *Loxoconcha lilljeborchi* BRADY, 1868. Another species, not yet described, from the Gulf of California is known to belong to this genus. The surface ornament varies from a moderately reticulate form with no other distinguishing characters other than the posterodorsal horn (e.g., *L. postdorsolatum*) to a form with a conspicuous eye tubercle, a posteroventral protuberance, and three prominent anteromedian ridges (e.g., *L. fischeri*). All forms have a tendency to develop the three prominent horizontal anteromedian ridges, but not all equally well.

The genus is predominantly American, originating prior to the Miocene from a loxoconchid stock. It is now known from the Caribbean region, Trinidad, Florida, Gulf of Mexico, and Gulf of California.

EXPLANATION OF PLATE 5

PTERYGOCYTHEREIS, CYTHERETTA, PROTOCYTHERETTA

(All illustrated forms are from the eastern Gulf of Mexico)

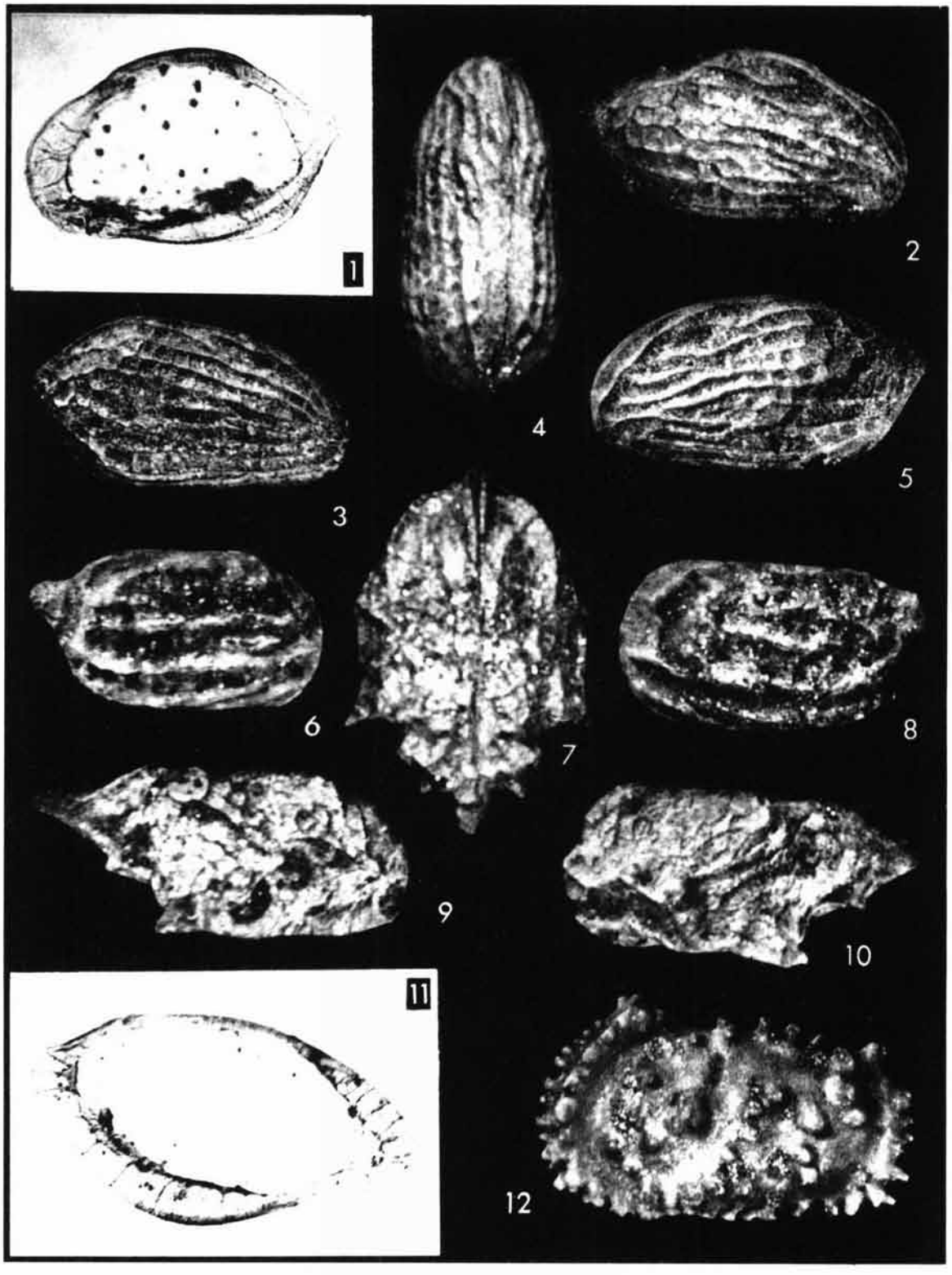
FIGURE — PAGE

1-3.—Pterygocythereis sp. aff. *P. americana* (ULRICH & BASSLER), 1904; *1,* exterior lateral view of right valve of specimen with dorsal crest, ×70; *2,* exterior lateral view of left valve of specimen without dorsal crest, ×75; *3,* dorsal view of specimen without dorsal crest, ×65 22

4,6,8.—Cytheretta? sahnii PURI, 1952; *4,* exterior lateral view of left valve; *6,* exterior lateral view of right valve; *8,* dorsal view; all ×55 25

5,7,9,10.—Protocytheretta daniana (BRADY), 1869, showing the reticulate surface and the characteristic loops formed by the median ridges; *5,* dorsal view, ×65; *7,* exterior lateral view of right side of whole carapace of male, ×65; *9,* exterior lateral view of left valve of female, ×60; *10,* exterior lateral view of left valve of female, ×65 26

BENSON & COLEMAN — Recent Marine Ostracodes, Eastern Gulf of Mexico



BENSON & COLEMAN — Recent Marine Ostracodes, Eastern Gulf of Mexico

LOXOCORNICULUM FISCHERI (Brady, 1869) Benson & Coleman, (n. comb.)

Pl. 7, Figs. 3, 4; Fig. 24

Cythere? fischeri BRADY, 1869, p. 154, pl. 18, figs. 15, 16; MÜLLER, 1912, p. 374.

Loxoconcha fischeri (Brady), KRUIT and KEY, *in* VAN ANDEL & POSTMA, 1954, p. 225, pl. 25, fig. 3.

Loxoconcha antillea VAN DEN BOLD, 1946, p. 110, pl. 18, fig. 3; ———, 1950, p. 86; ———, 1957, p. 244, pl. 2, fig. 7.

Description. Carapace medium-sized, robust, subquadrate, inflated, rhomboidal in dorsal view, with conspicuous spines on posterior end, highest and widest near median line, subrhomboidal to subquadrate in lateral view; dorsum and venter straight, with slight ventral sinuation; anterior margin narrowly rounded, produced below mid-line, truncate anterodorsally; posterior upswept, produced above mid-line. Surface moderately to coarsely reticulate, with irregular pits and ridges over most of the carapace with long axes becoming concentric with the ventral and posterior margins; prominent hornlike protuberance, which may be only partly reticulate, on posterodorsum; short, prominent, crescentic, posteroventral ridge; two or three prominent horizontal anteromedian ridges formed by reticulations near anterior margin; prominent eye tubercle. Males more elongate, with finer reticulate surface than females.

Hinge gongylodont with conspicuously crenuate median element. Narrow vestibules in anterior and posterior regions; radial-pore canals moderate in number.

Dimensions. Length of adult female 0.53 mm; height 0.35 mm; width 0.29 mm. Length of adult male 0.60 mm; height 0.35 mm; width 0.30 mm.

Material. Specimens examined 27.

Remarks. Cythere fischeri is here designated as the type-species of *Loxocorniculum* BENSON & COLEMAN. It can be distinguished from *L. postdorsolatum* (PURI) by the presence of a posteroventral ridge and coarser reticulate surface. The difference between *L. fischeri* and *L. rugosum* has not been made clear by VAN DEN BOLD.

Occurrence. Moderately common in Florida Bay, rare to common in the eastern Gulf of Mexico. Found by VAN DEN BOLD in the Miocene of Trinidad, Cuba, Guatamala, and Venezuela. Originally described by BRADY (1869) from the Caribbean near Colon, Panama. Found during the present study throughout the north-south extent of the area of investigation; complete carapaces were found at localities 1, 17, 18, 20, and 34, and more than one single valve from localities 8, 27, 29, and 30. Depth range 27 to 92 feet; most abundant in depths greater than 75 feet; salinity range 36.33 to 37.39‰.

LOXOCORNICULUM POSTDORSOLATUM (Puri, 1960) Benson & Coleman, (n. comb.)

Pl. 7, Figs. 1, 2; Fig. 25

Loxoconcha postdorsolatum PURI, 1960, p. 111, pl. 3, figs. 17, 18, text-figs. 35, 37.

Loxoconcha anderseni Puri, PURI & HULINGS, 1957, fig. 11.

Diagnosis. Distinguished by its moderately reticulate carapace, subcircular pits becoming elongate and concentric submarginally, large size, and lack of prominent ridges.

Description. Carapace medium-sized, subrhomboid to ovate, lenticular in dorsal view, highest and widest posterior to mid-line, subrhomboidal, loxoconchid in lateral view; dorsal margin of male straight, of female slightly arched; venter sinuous, with slight concavity anterior to center; anterior margin broadly rounded below, obliquely truncate above; posterior margin obliquely rounded below, obliquely truncate above, with short subdorsal caudal extension. Surface reticulate concentrically about point of

EXPLANATION OF PLATE 6

CYTHERURA, HEMICYTHERURA, PARACYTHERIDEA, PELLUCISTOMA, ACTINOCYTHEREIS

(All illustrated forms are from the eastern Gulf of Mexico)

FIGURE — PAGE

1-5.—Cytherura johnsoni MINCHER, 1941, showing the variation in shape but relative consistency in surface ornament; *1,* interior lateral view of a tilted right valve, not showing accurate lateral outline but showing internal features, transmitted light, ×85; *2,* exterior lateral view of right valve, ×85; *3,* exterior lateral view of right valve, ×85; *4,* dorsal view, ×90; *5,* exterior lateral view of left valve, ×85 31

6,8.—Hemicytherura sablensis BENSON & COLEMAN, n.sp.; *6,* exterior lateral view of right valve; *8,* exterior lateral view of left valve, both ×110 33

7,9,10.—Paracytheridea tschoppi VAN DEN BOLD, 1946; *7,* dorsal view, ×135; *9,* exterior lateral view of right valve, ×75; *10,* exterior lateral view of left valve, ×75 33

11.—Pellucistoma magniventra EDWARDS, 1944; interior lateral view of left valve, transmitted light, ×90 41

12.—Actinocythereis sp. aff. *A. exanthemata* (ULRICH & BASSLER), 1944; exterior lateral view of left valve of male, showing the irregular distribution of the median lateral spines, ×125 48

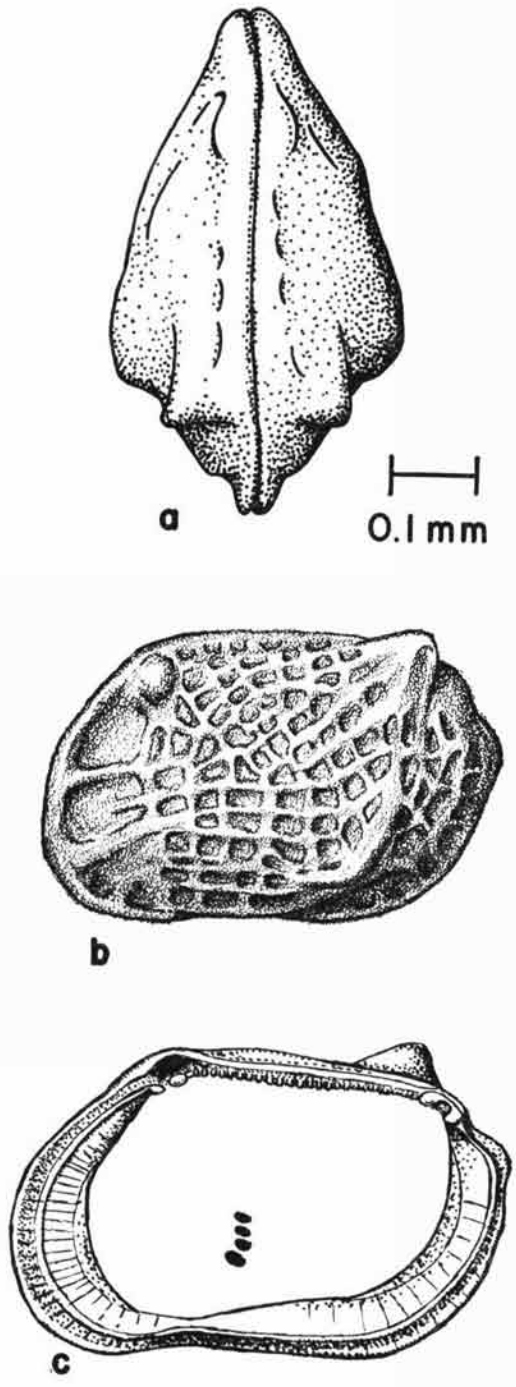


FIG. 24. *Loxocorniculum fischeri* (BRADY), 1869, the type-species of the genus *Loxocorniculum*.—*a*. Generalized dorsal view of a complete carapace of a female.—*b*. Carbon sketch of the exterior lateral view of the left valve of an adult female showing the surface ornamentation.—*c*. Interior view of the right valve of an adult female showing a slightly modified gongylodont hinge and the marginal area.

maximum width of carapace except in posterodorsal region, in which lines of reticulation converge toward and extend along prominent horn; pits subcircular in central, anterior, and dorsal areas of carapace, becoming elongate ventrally and posteriorly. Females slightly more coarsely reticulate than males.

Hinge gongylodont, typical of genus. Marginal area moderately broad, with narrow vestibules developed anteriorly and posteriorly. Muscle-scar pattern obscured by ornamentation. Radial-pore canals few.

Dimensions. Length of adult female specimen 0.54 mm; height 0.34 mm; width 0.31 mm. Length of adult male 0.62 mm; height 0.37 mm; width 0.31 mm.

Material. Specimens examined 156, of which 92 had both valves intact.

Remarks. Sexual dimorphism is present in this species. The adult females are more coarsely reticulate and shorter than the males, but have approximately the same height and width. *Loxocorniculum postdorsolatum* is larger than *L. anderseni* described by PURI (1953d, p. 269) from the Miocene of Florida, but it is about the same in size as *L. fischeri*. The anterior longitudinal ridges are present in *L. postdorsolatum* as in *L. fischeri* but are usually subdued and sometimes absent.

HARTMANN (1956, p. 49) described a new species, *Loxoconcha bullata,* from the coast of Brazil that is very similar to *Loxocorniculum postdorsolatum* in shape, general surface texture, and the presence of the posterodorsal protuberances. Only by examination of type material of the former species can its relationship be determined.

Occurrence. Loxocorniculum postdorsolatum was described by PURI (1960, p. 111) from the Recent of Florida Bay and Alligator Harbor; PURI & HULINGS (1957, p. 183, 188) had previously reported it from Recent sediment in the Alligator Harbor area of the Gulf of Mexico and from Florida Bay under the name of *Loxoconcha anderseni. L. postdorsolatum* was found in the eastern Gulf of Mexico throughout the north-south extent of the area of investigation; it is particularly abundant in the southern parts of the study area at localities 1-5, 12, 15, 36, and 37. Depth range 19 to 63 feet, although most abundant at depths less than 35 feet; salinity range 36.23 to 39.92‰.

Family PARADOXOSTOMATIDAE Müller, 1894
Subfamily CYTHEROMATINAE Elofson, 1939
Genus PELLUCISTOMA Coryell & Fields, 1937

Pellucistoma CORYELL & FIELDS, 1937, p. 17; EDWARDS, 1944, p. 528; VAN DEN BOLD, 1946, p. 35; BENSON, 1959, p. 58; POKORNÝ, 1958, p. 299; SYLVESTER-BRADLEY, 1961, p. Q317.

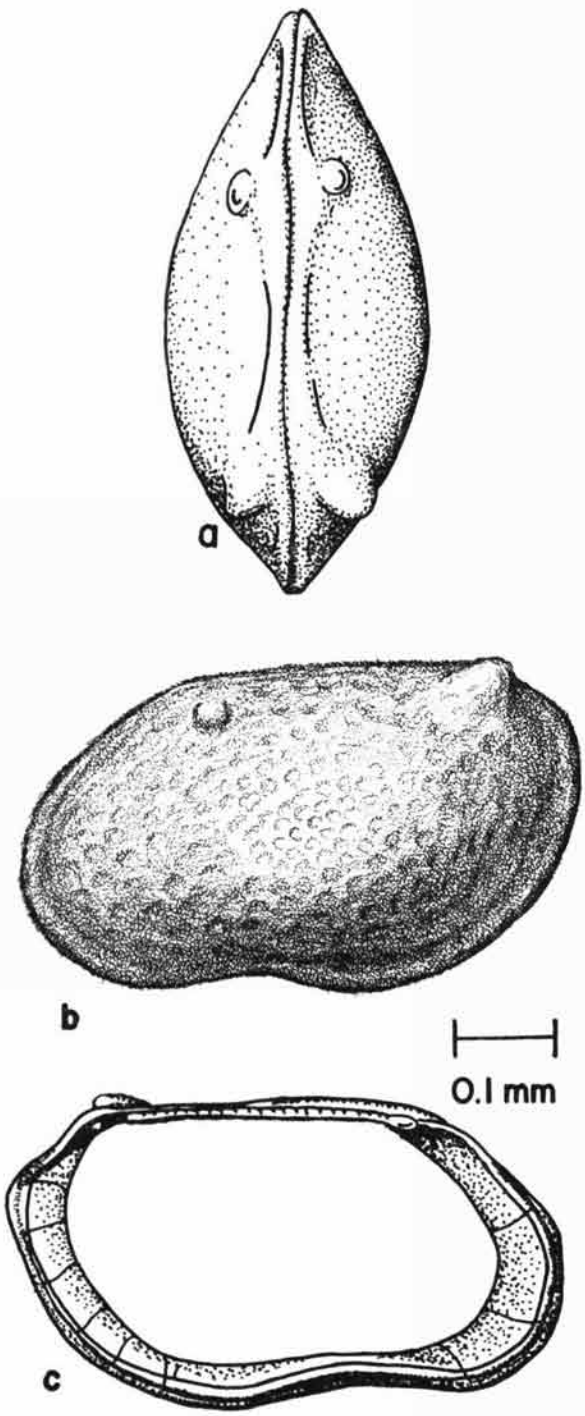


FIG. 25. *Loxocorniculum postdorsolatum* (PURI), 1960. —*a*. Generalized dorsal view of a complete male carapace. —*b*. Carbon sketch of an exterior lateral view of the left valve of an adult male.—*c*. Interior view of the left valve of an adult male showing the hinge and marginal area.

Type-species. Pellucistoma howeii CORYELL & FIELDS, 1937, p. 17, fig. 18a,b,c.

Diagnosis. Recognized by its small, smooth, lenticular, spatulate carapace, with subdorsal caudal process. Hinge of left valve consisting of anterior bladelike tooth, postjacent serrate bar, and dorsal groove. Duplicature wide in some species with irregular line of concrescence and broad anterior vestibule. *Mio.-Rec.*

PELLUCISTOMA MAGNIVENTRA Edwards, 1944

Pl. 6, Fig. 11; Fig. 26

Pellucistoma magniventra EDWARDS, 1944, p. 528, pl. 88, figs. 33-35; PURI, 1953d, p. 289, pl. 15, fig. 4, text-fig. 12a; PURI & HULINGS, 1957, p. 174, 176, 183; PURI, 1960, p. 119, pl. 2, fig. 10, text-figs. 8, 9.

Pellucistoma sp. cf. *P. magniventra* Edwards, SWAIN, 1951, p. 52.

Paradoxostoma ensiforme Brady, SWAIN, 1953, p. 633, pl. 63, fig. 7.

Diagnosis. Distinguished by its medium-sized, smooth, elongate-subquadrate carapace. Anterior margin narrowly rounded below, highly oblique above, merging gradually with dorsal margin; posterior narrowly rounded.

Dimensions. Length of adult specimen 0.71 mm; height 0.39 mm; width 0.26 mm.

Material. Specimens examined 57, of which 30 had both valves intact.

Remarks. Specimens found in the Gulf of Mexico are somewhat more elongate and more narrowly rounded posteriorly than those described by EDWARDS, but these differences are of degree only and do not warrant the erection of a new species. This species differs from *P. howei* CORYELL & FIELDS, 1937, in having a more obliquely rounded anterior margin, an arched dorsal margin, and in being generally more elongate. CURTIS (1960) found *Pellucistoma* aff. *P. howei* in the nearshore and estuarine areas of the Mississippi Delta. This form may be a variant of the one identified by PURI (1960) and included in the present study. From the illustration (pl. 2, fig. 3) of CURTIS the posterior margin seems to be more rounded than was usually observed in the eastern Gulf forms, but as it was not described in the text, a comparison may not be justifiable. We do not agree with SWAIN's identification of the form called by him *Paradoxostoma ensiforme* BRADY (1868b, p. 460, pl. 35, figs. 8-11). *P. ensiforme* is convex, not concave, in the posterodorsum; it is more elongate; and the anterior is much more narrowly rounded. SWAIN's form from San Antonio Bay appears to be a pellucistomid, probably *Pellucistoma magniventra* EDWARDS.

Occurrence. Reported by EDWARDS (1944, p. 528) from the Miocene Duplin marl of North Carolina,

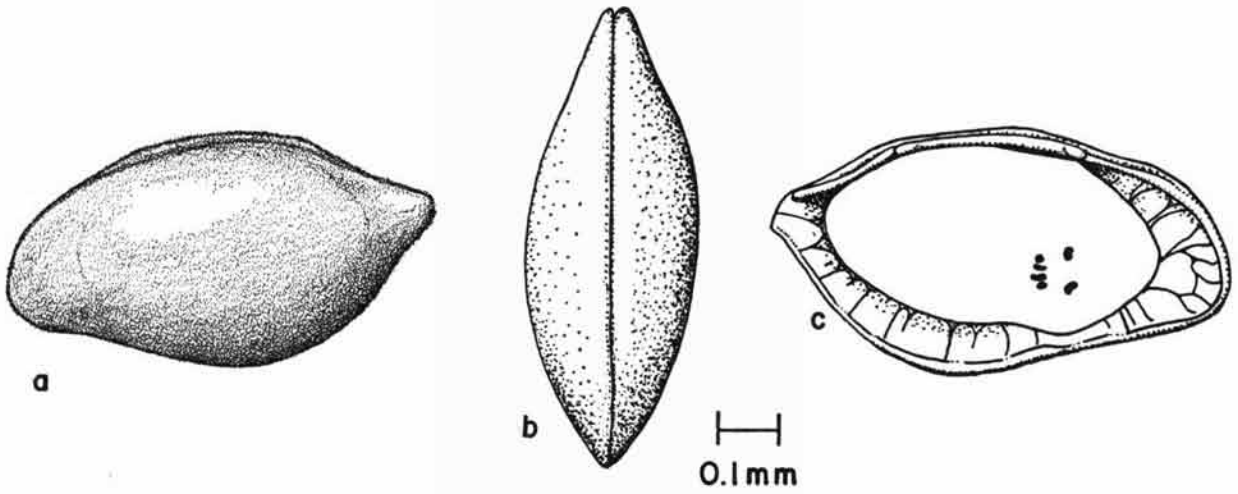


FIG. 26. *Pellucistoma magniventra* EDWARDS, 1944.—a. Carbon sketch of the exterior lateral view of the left valve of an adult specimen showing the overreach of the right valve along the dorsum.—*b*. Dorsal view of a complete specimen showing the equality of the valves in the anterior and posterior.—*c*. Interior view of the left valve of an adult specimen.

by SWAIN (1951, p. 52) from the upper Miocene of the subsurface of North Carolina; by PURI (1953d, p. 290) from the *Cancellaria* facies of the Choctawhatchee Stage of the Miocene of Florida, and by PURI & HULINGS (1957, p. 176, 183) and PURI (1960, p. 119) from Recent sediments of the Panama City and Alligator Harbor areas. Forms we believe to be probably synonymous with *Pellucistoma magniventra* were found by SWAIN (1955) from San Antonio Bay and by CURTIS (1960) from the eastern Mississippi Delta. Found in scattered pockets in the eastern Gulf of Mexico from latitude 24° 59.0'N to the northern edge of the area of investigation; abundant at localities 2, 3, 5, 15-18, and 24. Depth range 24 to 63 feet, although most abundant at depths less than 35 feet; salinity 35.01 to 39.92‰. Frequently associated with *Cytherura johnsoni* and *Paracytheridea tschoppi;* in the northern part of the area also with *Cytheretta? sahnii* and at southern localities with *Loxocorniculum postdorsolatum*.

Family TRACHYLEBERIDIDAE Sylvester-Bradley, 1948

Genus PURIANA Coryell, in Puri, 1953

Favella CORYELL & FIELDS, 1937, p. 8; EDWARDS, 1944, p. 523 (*non Favella* JORGENSEN, 1925).

Puriana CORYELL, *in* PURI, 1953c, p. 751; BENSON, 1959, p. 60; SYLVESTER-BRADLEY, 1961, p. Q341.

Type-species. Favella puella CORYELL & FIELDS, 1937, p. 8, figs. 8a-c, immature instar [=*Cythereis rugipunctata gatunensis* CORYELL & FIELDS, 1937, p. 10, fig. 11a].

Diagnosis. Distinguished from other genera of the family Trachyleberididae by its moderately small,

EXPLANATION OF PLATE 7

LOXOCORNICULUM, LOXOCONCHA

(All illustrated forms are from the eastern Gulf of Mexico)

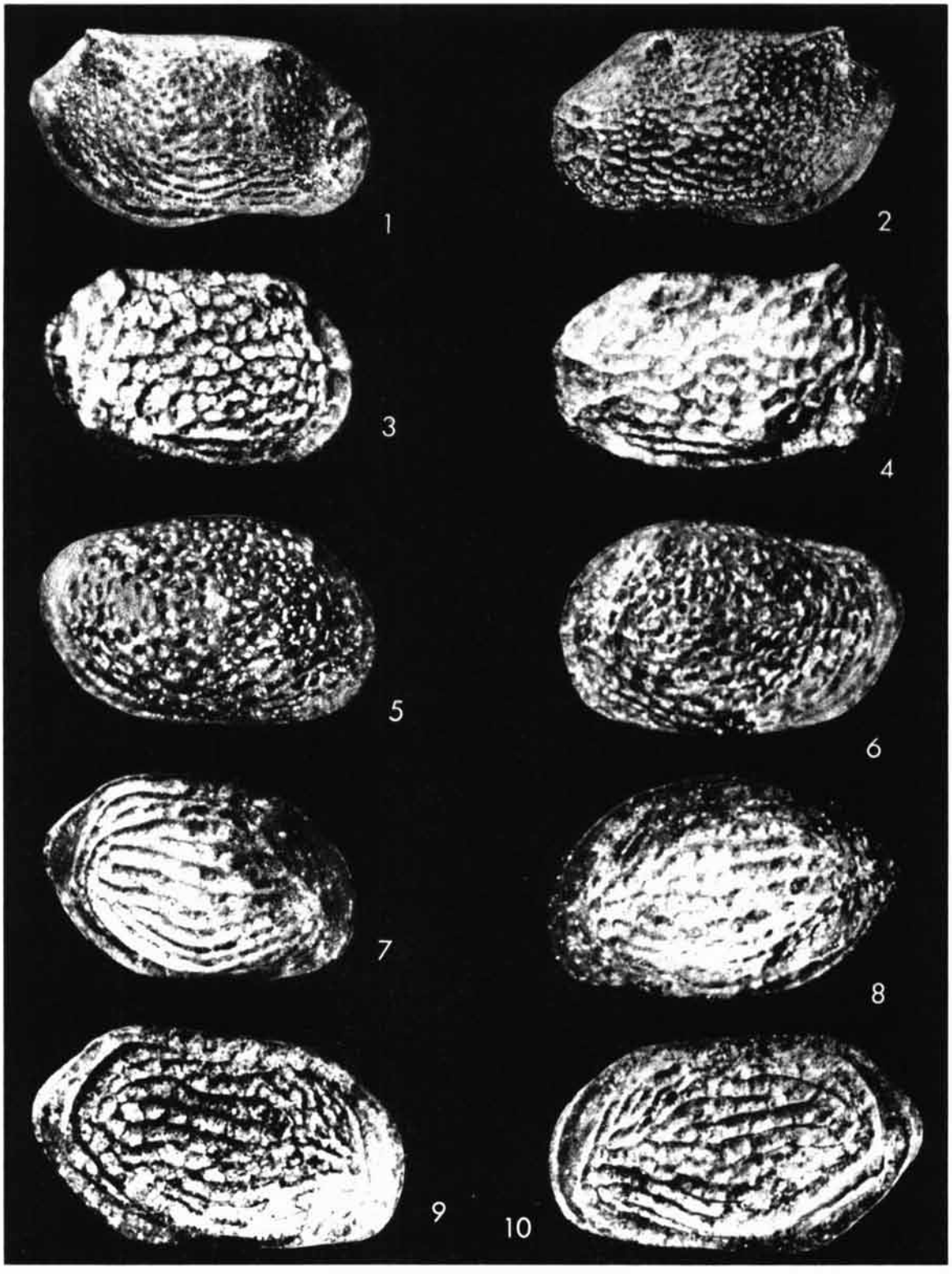
FIGURE PAGE

1,2.—Loxocorniculum postdorsolatum (PURI), 1960, male; *1,* exterior lateral view of left valve; *2,* exterior lateral view of right valve; both ×90 39

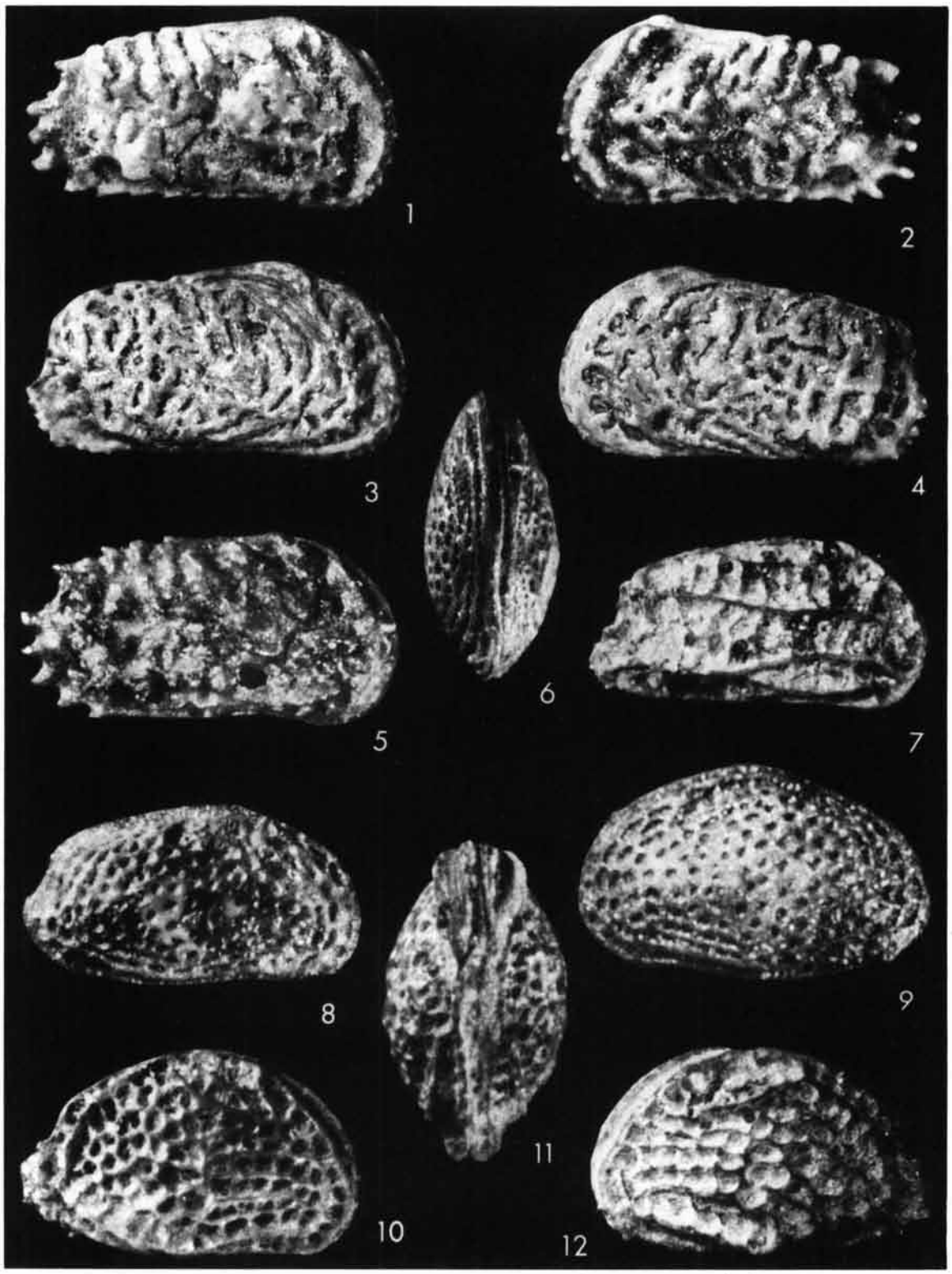
3,4.—Loxocorniculum fischeri (BRADY), 1869; *3,* exterior lateral view of left valve of female, ×90; *4,* exterior lateral view of right valve of male, ×105 39

5,6.—Loxoconcha sp. aff. *L. australis* BRADY, 1880, showing the characteristic ovate lateral shape with the punctate surface and subventral grooves; *5,* exterior laeral view of left valve; *6,* exterior lateral view of right valve; both ×100 .. 37

7-10.—Loxoconcha sarasotana BENSON & COLEMAN, n. sp., showing the characteristic marginal ridges veloped from the reticulate surface; *7,* exterior lateral view of left valve of female, ×80; *8,* exterior lateral view of right valve of female, ×90, *9,* exterior lateral view of left valve of male, ×90; *10,* exterior lateral view of right valve of male, ×90 37



BENSON & COLEMAN — Recent Marine Ostracodes, Eastern Gulf of Mexico



BENSON & COLEMAN — Recent Marine Ostracodes, Eastern Gulf of Mexico

subquadrate carapace, ornamented by posterodorsal subvertical and lateral ridges, spines, and knobs, anterior marginal rim, subcentral tubercle, and three to five heavy spines on posteroventral margin. Hinge holamphidont; that of right valve consisting of large, smooth, ovate anterior tooth with postjacent socket, smooth median tooth, and large, smooth, ovate posterior tooth. Marginal area moderately broad, sometimes with narrow vestibules. Radial-pore canals few, irregular. *Mio.-Rec.*

Ecology. Associations of this genus are not well known beyond the fact that it is typically marine. Depth range is from very shallow water to more than 50 fathoms.

Remarks. SYLVESTER-BRADLEY (1961), in the section on the Trachyleberididae in the *Treatise of Invertebrate Paleontology* stated that *Puriana* has been usually interpreted by reference to *Cythere rugipunctata* ULRICH & BASSLER. This is because of inaccessibility of specimens of the type-species *Favella puella* CORYELL & FIELDS and because the holotype is an instar. From examination of the types in the American Museum of Natural History (New York) it is evident that the specimen designated as *Favella puella* CORYELL & FIELDS is an instar of the species represented by specimens designated as *Cythereis rugipunctata gatunensis* CORYELL & FIELDS (1937, p. 10), and that the latter name is a junior synonym of *Favella puella* [correctly called *Puriana puella,* because *Favella* was preoccupied, by subsequent designation (CORYELL, in PURI, 1953c)].

Puriana puella (CORYELL & FIELDS) does differ from *Puriana rugipunctata* (ULRICH & BASSLER), but the differences are only on the specific level. *P. puella* is closely related to *P. pacifica* BENSON (1959, p. 60), in which the posterodorsal punctae or ridges are more subdued and discontinuous than in *P. rugipunctata.* In *P. puella* these ridges or punctae are still prominent, though discontinuous. *Puriana fissispinata,* described for the first time in this report, demonstrates another variation in configuration of surface ornament that is possible within the genus. PURI (1960) has described still another new species, *P. floridana,* in which the posteroventer has randomly oriented spines. We are not sure if this character is constant or recognizable, but it is typical of the evolutionary changes taking place in *Puriana.*

The suggested placement by SYLVESTER-BRADLEY, 1961 of *Puriana* in synonymy with *Carinocythereis* RUGGIERI, 1956, is not consistent with the characteristics of the two genera, which are quite dissimilar on the lower taxonomic level.

PURIANA RUGIPUNCTATA (Ulrich & Bassler), 1904

Pl. 8, Figs. 1, 2, 5; Fig. 27

Cythere rugipunctata ULRICH & BASSLER, 1904, p. 118, pl. 18, figs. 16, 17.

Cythereis rugipunctata (Ulrich & Bassler), HOWE AND OTHERS, 1935, p. 23, pl. 1, figs. 18, 20-22, pl. 4, figs. 22, 23.

Favella rugipunctata (Ulrich & Bassler), EDWARDS, 1944, p. 524, pl. 88, figs. 5, 6; VAN DEN BOLD, 1946, p. 100, pl. 10, fig. 3; ———, 1950, p. 86.

Trachyleberis rugipunctata (Ulrich & Bassler), SWAIN, 1951, p. 38, pl. 6, fig. 8.

Puriana rugipunctata (Ulrich & Bassler), PURI, 1953c, p. 751; ———, 1953d, p. 257, pl. 12, figs. 18, 19, text-fig. 8k; PURI & HULINGS, 1957, p. 174, 176, 183; MCLEAN, 1957, p. 89, pl. 11, fig. 5a-d; PURI, 1960, p. 126, pl. 6, fig. 18.

Diagnosis. Distinguished by its rugose ornamentation, consisting of series of rounded ridges, which are irregularly arranged in front of strong subcentral tubercle; series of four or five transverse ridges present along posterodorsal margin, disappearing at midline. Cluster of nodes in posteroventral portion of carapace.

EPXLANATION OF PLATE 8

PURIANA, ORIONINA, AURILA

(All illustrated forms are from the eastern Gulf of Mexico)

FIGURE PAGE

1,2,5.—Puriana rugipunctata (ULRICH & BASSLER), 1904; *1,* exterior lateral view of right valve of rugose specimen; *2,* exterior lateral view of left valve of rugose specimen; *5,* exterior lateral view of right valve of spinose specimen; all ×100 43

3,4.—Puriana fissispinata BENSON & COLEMAN, n.sp.; *3,* exterior lateral view of right valve; *4,* exterior lateral view of left valve; both ×100 44

7.—Orionina bermudae (BRADY), 1880; exterior lateral view of right valve, ×105 45

6,8,9.—Aurila amygdala (STEPHENSON), 1944; *6,* dorsal view, ×80; *8,* exterior lateral view of right valve, ×90; *9,* exterior lateral view of left valve of same specimen, showing difference in shape of the two valves, ×95 36

10-21.—Aurila conradi (HOWE & MCGUIRT) *floridana* BENSON & COLEMAN, n. subsp., showing the delicate continuous reticulation; *10,* exterior lateral view of right valve, ×85; *11,* dorsal view, ×80; *12,* exterior lateral view of left valve, ×85 35

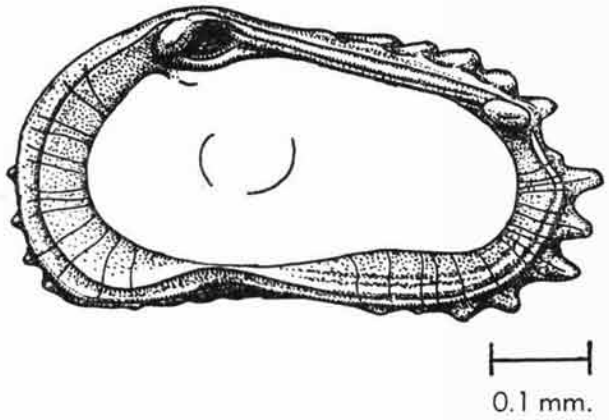


FIG. 27. *Puriana rugipunctata* (ULRICH & BASSLER), 1904. Interior view of an adult right valve.

Dimensions. Length of adult specimen 0.58 mm; height 0.34 mm; width 0.35 mm.

Material. Specimens examined 61, of which 39 had both valves intact.

Remarks. Many of the specimens appear identical to previously described ones assigned to this species; however, considerable variation is observed among those collected in the Gulf of Mexico, with several of the specimens exhibiting spinose ornamentation rather than ridges. The identification of spinose specimens as *P. rugipunctata* is based on the fact that spines appear in the exact spots normally occupied by ridges, and on the occurrence of both forms at the same localities. Further study may demonstrate that the spinose form belongs to a separate species.

Occurrence. Described originally by ULRICH & BASSLER (1904, p. 118) from Miocene sediments of Maryland. Other reported Miocene occurrences: Panama, by CORYELL & FIELDS (1937, p. 10); Duplin marl of North Carolina, by EDWARDS (1944, p. 524); Cuba, Guatemala, and British Honduras, by VAN DEN BOLD (1946, p. 100); subsurface of North Carolina, by SWAIN (1951, p. 257). Reported by PURI & HULINGS (1957, p. 176, 183) and PURI (1960, p. 126) from Recent sediments of the Panama City and Alligator Harbor areas of the Gulf of Mexico and from Florida Bay. Found in the eastern Gulf of Mexico throughout the north-south extent of the area of investigation; abundant at the scattered localities 3, 15, 18, 30, 31, 36, 38. Depth range 19 to 239 feet, although somewhat more abundant at depths less than 50 feet; salinity range 35.01 to 39.92‰. Frequently associated with *Paracytheridea tschoppi*, often with *Aurila conradi floridana*.

PURIANA FISSISPINATA Benson & Coleman, n.sp.

Pl. 8, Figs. 3, 4; Fig. 28

Diagnosis Distinguished by its large carapace. ornamented by irregular pattern of short, smooth ridges, and bifid posterior marginal spines.

Description. Carapace moderately large, subquadrate, highest anterior to mid-line; widest just anterior to mid-line; dorsal margin straight, appearing arched posteriorly because of overhang of posterodorsal area of carapace; venter very slightly concave; anterior margin broadly rounded below, obliquely rounded above; posterior margin straight to slightly concave above, narrowly rounded below. Surface covered by low, rounded ridges, forming anastomosing pattern posteriorly; three or four coarser ridges present in anterior part of carapace, parallel to anterior margin; anterior marginal ridge high, smooth, rounded; subcentral node low, indistinct; sharp posterior transverse ridge beneath posterior cardinal angle, behind which carapace is much narrower; anterior margin notched rather than denticulate; posterior margin bearing three large bifid spines below mid-line with two smaller, simple spines beneath.

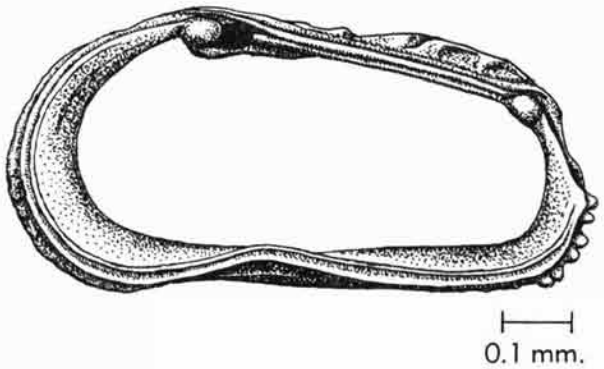


FIG. 28. *Puriana fissispinata* BENSON & COLEMAN, n. sp. Interior view of an adult right valve.

Hinge typical of genus. Line of concrescence and inner margin coincident. Marginal area moderately broad, selvage well developed around free margins. Muscle-scar pattern indistinct. Radial-pore canals numerous, simple, straight.

Ecology. From the present information this species seems to be restricted to marine benthos more than 75 feet deep.

Dimensions. Length of an adult left valve 0.87 mm; height 0.44 mm.

Material. Specimens examined 24, of which none had both valves intact.

Remarks. This species is larger than any previously described form assigned to *Puriana*. The ornamentation is similar to that of *P. rugipunctata*, but the ridges are narrower and lower, and no transverse ridges occur in the posterior part of the carapace. Some specimens are more elongate than others.

Puriana fissispinata is similar to the illustration of *Cythere parallelogramma* BRADY (1880, p. 82, pl. 15, fig. 1a-e). However, *P. fissispinata* has a drawn-out caudal process, and its reticulations are more enclosed. Both forms are about the same size (0.85 mm). *Cythere parallelogramma* was described from Prince Edward Island in the Southern Ocean.

Occurrence. Found in the eastern Gulf of Mexico from latitude 25° 29.0'N to the northern edge of the area of investigation; common at locality 30, found also at localities 8, 20, 21, and 29. Depth range 76 to 92 feet; salinity range 36.27 to 36.82‰. Associated with *Bairdia victrix, Cytherella grossmani, Paracytheridea tschoppi, Echinocythereis garretti,* and *Hulingsina ashermani.*

Genus ORIONINA Puri, 1953

Orionina PURI, 1953d, p. 254; POKORNÝ, 1958, p. 264; SYLVESTER-BRADLEY, 1961, p. Q339.

Type-species. Cythere vaughani ULRICH & BASSLER, 1904 [=*C. serrulata* BRADY, 1868c, p. 153, pl. 18, figs. 11, 12 (*non C. serrulata* BOSQUET, 1854)=*C. bermudae* (BRADY) by BRADY, 1880, p. 90].

Diagnosis. Recognized by its medium-sized, elongate subtriangular carapace, open reticulate surface with 2 to 4 well-developed longitudinal ridges; subdued caudate posterior. Radial-pore canals numerous. Hinge holamphidont; that of right valve consisting of anterior lobate tooth with postjacent socket, median groove, and smooth, ovate posterior tooth. *Eoc.-Rec.*

ORIONINA BERMUDAE (Brady), 1880

Pl. 8, Fig. 7; Fig. 29

Cythere serrulata BRADY, 1868c, p. 153, pl. 18, figs. 11, 12 [*non C. serrulata* BOSQUET, 1854].

Cythere bermudae BRADY, 1880, p. 90, pl. 21, fig. 2a-d [new name].

Cythere vaughani ULRICH & BASSLER, 1904, p. 109, pl. 38, figs. 25-27.

Cythereis vaughani (Ulrich & Bassler), HOWE AND OTHERS, 1935, p. 25, pl. 3, figs. 24-26, pl. 4, fig. 13; CORYELL & FIELDS, 1937, p. 9, fig. 10a; EDWARDS, 1944, p. 522, pl. 87, fig. 27, 28; VAN DEN BOLD, 1946, p. 88, pl. 10, fig. 1; ———, 1950, p. 83.

Cythereis (Elofsonella) reticulata HARTMANN, 1956, p. 36, figs. 45-52.

Trachyleberis vaughani (Ulrich & Bassler), SWAIN, 1951, p. 37, pl. 6, fig. 6, 7.

Orionina vaughani (Ulrich & Bassler), PURI, 1953d, p. 254, pl. 12, figs. 15, 16, text-figs. 8a-c; MCLEAN, 1957, p. 88, pl. 11, fig. 6a,b.

Orionina bermudae (Brady), PURI & HULINGS, 1957, p. 174; VAN DEN BOLD, 1958, p. 403, pl. 5, fig. 9; PURI, 1960, p. 123, pl. 1, figs. 15, 16.

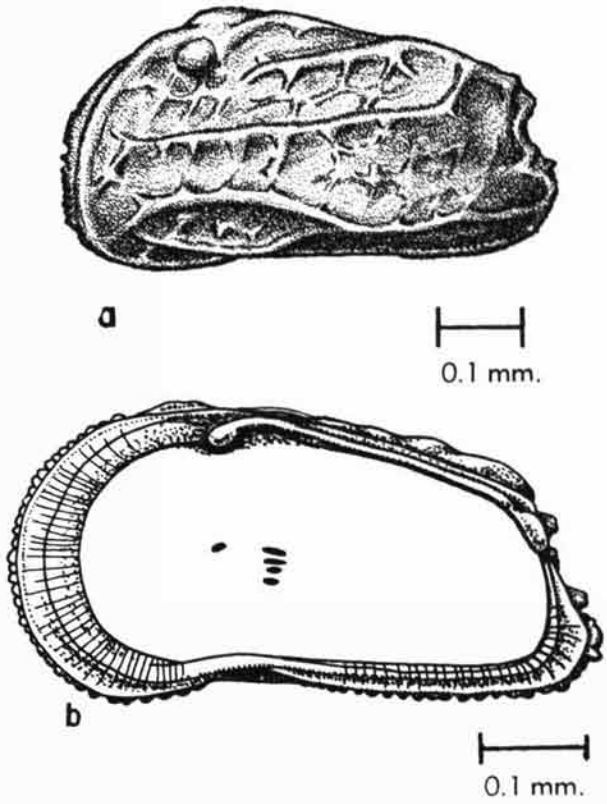


FIG. 29 *Orionina bermudae* (BRADY), 1880.—*a.* Carbon sketch of the exterior lateral view of the left valve of an adult specimen.—*b.* Internal view of the right valve of an adult specimen.

Diagnosis. Distinguished by its elongate subquadrate carapace, ornamented by three longitudinal ridges trending from posterodorsal to anteroventral margin; lower ridge bifurcating just behind mid-line; number of transverse ridges forming angularly reticulate pattern; anterior, ventral, and posteroventral margins extremely finely denticulate. *Mio.-Rec.*

Dimensions. Length of adult specimen 0.58 mm; height 0.32 mm; width 0.25 mm.

Material. Specimens examined 9, of which 5 had both valves intact.

Remarks. The specimens examined appear identical to those described and illustrated by BRADY (1880, p. 90) and are indistinguishable, except for slightly smaller size, from those identified by several authors as *O. vaughani.*

Occurrence. Reported by BRADY (1880, p. 90) from a depth of 435 fathoms off Bermuda, and by PURI & HULINGS (1957, p. 188) and PURI (1960, p. 126) from Florida Bay. Reported from Miocene sediments by several authors: from Maryland, by ULRICH & BASSLER

(1904, p. 109); from the *Arca* facies of the Choctawhatchee Stage of the Miocene of Florida, by HOWE AND OTHERS (1935, p. 25); from the Duplin Marl of North Carolina, by EDWARDS (1944, p. 522); from the Yorktown Formation (Miocene) of Virginia, by MCLEAN (1957, p. 89); from the Miocene of Cuba, Guatemala, and British Honduras, by VAN DEN BOLD (1946, p. 88); and Venezuela, by VAN DEN BOLD (1950); from the subsurface Miocene of North Carolina, by SWAIN (1951, p. 37); from the Chipola facies of the Alum Bluff Stage, and from the *Ecphora, Arca,* and *Cancellaria* facies of the Choctawhatchee Stage of the Miocene of Florida, by PURI (1953d, p. 254). In addition, HOWE AND OTHERS (1935, p. 25) noted that "it occurs with increasing abundance in Miocene localities younger than the *Arca* zone of the Choctawhatchee, and is one of the commonest ostracodes in the Caloosahatchee Pliocene of Florida, and an almost identical form is living off the coast of Haiti." Found in the eastern Gulf of Mexico at two localities only; a single valve was found at locality 35, the rest at locality 3, at a depth of 27 feet, salinity 39.92‰.

Genus ECHINOCYTHEREIS Puri, 1953

Echinocythereis PURI, 1953d, p. 259; SYLVESTER-BRADLEY, 1961, p. Q336.

Type-species. Cythereis garretti HOWE & MCGUIRT, *in* HOWE AND OTHERS, p. 20, pl. 3, figs. 17-19, pl. 4, figs. 5, 15.

Diagnosis. Recognized by its moderately large, subrhomboidal to subovoid carapace, ornamented by numerous small, rounded spines arranged concentrically. Hinge holamphidont; that of right valve consisting of anterior crenulate tooth, postjacent socket, median groove, and posterior knoblike tooth. Marginal area broad. Radial pore canals numerous, long, straight. Muscle-scar pattern consisting of vertical row of four scars, with two additional scars located in front and two near ventral margin. *U.Cret.-Rec.*

Ecology. Marine, usually found offshore in deeper water; some species are characteristically abyssal.

ECHINOCYTHEREIS GARRETTI (Howe & McGuirt), in Howe and others, 1935

Pl. 4, Figs. 4, 5; Fig. 30

Cythereis garretti HOWE & MCGUIRT, *in* HOWE AND OTHERS, 1935, p. 20, pl. 3, figs. 17-19, pl. 4, figs. 5, 15.

Buntonia sp. cf. *B.? garretti* (Howe & McGuirt), SWAIN, 1951, p. 39, pl. 3, fig. 6, pl. 4, figs. 4-6.

Echinocythereis garretti (Howe & McGuirt), PURI, 1953d, p. 260, pl. 12, figs. 2-5, text-figs. 9a,b.

Diagnosis. Distinguished by its large, heavy, spinose carapace, with dorsal and ventral margins nearly parallel on female specimens. Surface covered with small, simple spines, arranged concentrically about center of valves. Posterior portion of dorsal margin overhung by swelling of median part of carapace. *U.Cret.-Rec.*

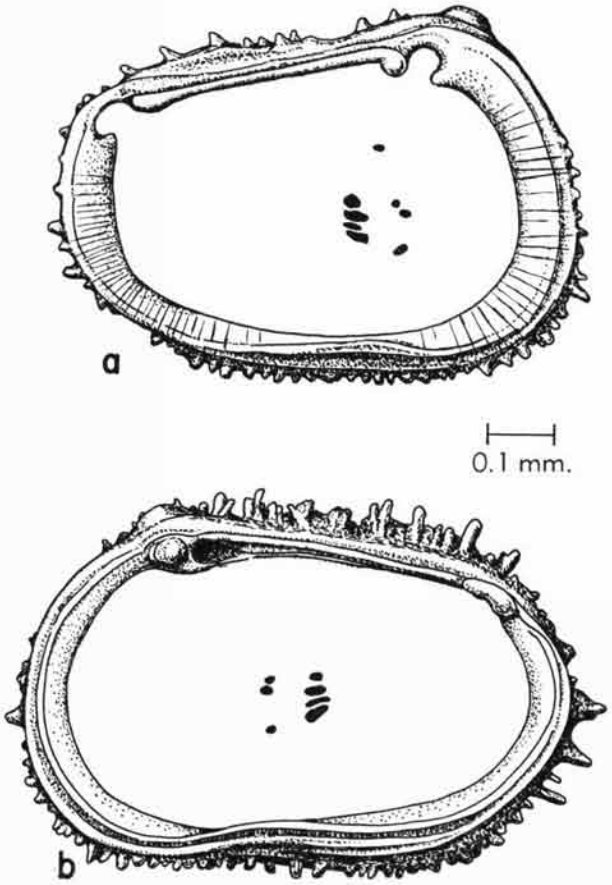


FIG. 30. *Echinocythereis garretti* (HOWE & MCGUIRT), 1935.—*a.* Interior view of the left valve of an adult specimen showing the hinge and marginal area.—*b.* Interior view of the right valve of an adult specimen showing the narrowly stepped anterior tooth and the elongate reniform posterior tooth.

Ecology. The Recent forms appear to prefer a benthonic habitat in water deeper than 60 feet.

Dimensions. Length of adult male 0.92 mm; height 0.53 mm; width 0.51 mm. Length of complete female carapace 0.84 mm; height 0.52 mm; width 0.50 mm. Length of a larger female right valve 0.92 mm; height 0.61 mm.

Material. Specimens examined 329, of which 9 had both valves intact.

Remarks. Sexual dimorphism is marked in this species, with males being somewhat more elongate than females and having nearly straight dorsal and ventral margins that converge toward the posterior.

The specimens found in the Gulf of Mexico differ from those illustrated by HOWE & MCGUIRT (1935, p. 3, fig. 18) in that the eye tubercle appears to be much more prominent; no mention of the size of the eye tubercle was made in the original description of the species.

Without any discussion or description CURTIS (1960, p. 481, pl. 1, fig. 19) illustrated a form from the Mississippi Delta that she identified as *Echinocythereis margaretifera* (BRADY), giving no date. We found such a species described by BRADY (1870) and listed by MÜLLER (1912) as a dubious species, but were unable to confirm the identification from BRADY's original study. The form illustrated by CURTIS appears to be identical to the one in the present report.

Echinocythereis sarsi (MÜLLER), 1894, is similar in shape to *E. garretti* but has the tips of its spines divided into many small spinelets. *E. irpex* (BRADY), which was described from the depths of the North Atlantic, is similar in shape but has the spines of the ventral areas arranged into clearly defined rows concentric with the margin and coalescing along the venter to form parallel ridges (BRADY, 1880, p. 107, pl. 17, fig. 2a-d). The eye tubercles of both *E. sarsi* and *E. irpex* are much more subdued than those of *E. garretti*. The form called *Buntonia* cf. *B. garretti* by SWAIN (1951, pl. 3, fig. 6) is identical to the form of the present report.

Occurrence. Not previously reported from Recent sediments. Described originally by HOWE & MCGUIRT (*in* HOWE AND OTHERS, 1935, p. 20) from the Arca facies of the Choctawhatchee Stage of the Miocene of Florida; reported by PURI (1953d, p. 260) from the *Arca, Ecphora,* and *Cancellaria* facies of the Choctawhatchee Stage. Found in the eastern Gulf of Mexico from latitude 25° 29.0′N to the northern edge of the area of investigation; abundant at localities 8, 20, 21, 27, and 29-34. Restricted to depths greater than 60 feet; salinity range 36.17 to 37.39‰. Frequently associated with *Paracytheridea tschoppi* and *Bairdia victrix*.

Genus ACTINOCYTHEREIS Puri, 1953

Actinocythereis PURI, 1953a, p. 178; ———, 1953d, p. 252; POKORNÝ, 1958, p. 262; SYLVESTER-BRADLEY, 1961, p. Q334-335.

Type-species. Cythere exanthemata ULRICH & BASSLER, 1904, p. 117, pl. 36, figs. 1-5.

Diagnosis. A trachyleberid with a holamphidont hinge, subcentral tubercle, and spines arranged in a dorsal row, a ventral row, and a midlateral row. *Eoc.-Rec., N.Am.; Marine.*

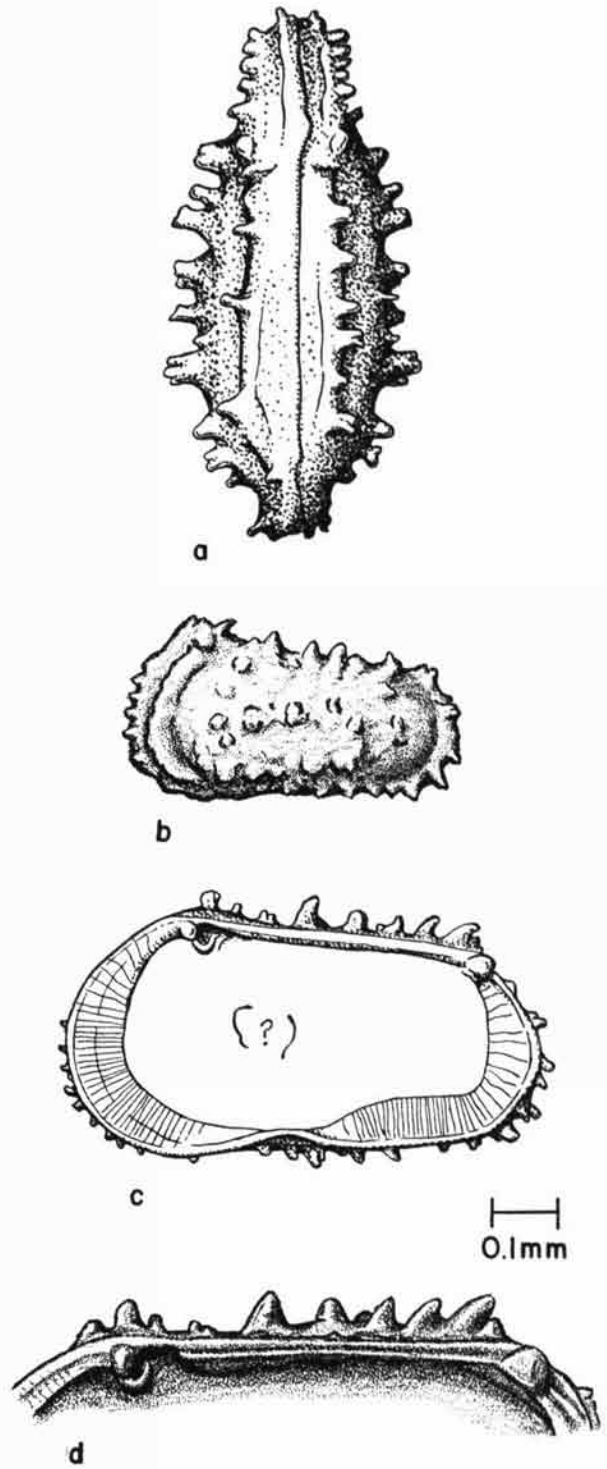


FIG. 31. *Actinocythereis* sp. aff. *A. exanthemata* (ULRICH & BASSLER), 1904.—*a.* Dorsal view of complete adult carapace. *b.* A carbon sketch of the exterior lateral view of the left valve of an adult male.—*c.* Interior view of an adult right valve of a male showing the hinge and marginal area.—*d.* Carbon sketch of the holamphidont hinge of an adult right valve.

ACTINOCYTHEREIS sp. aff. A. EXANTHEMATA (Ulrich & Bassler), 1904

Pl. 6, Fig. 12; Fig. 31

Discussion. A few scattered specimens of this form were found off the southern coast of Florida. Insufficient material was available for a systematic analysis. This form is apparently a descendant of *Actinocythereis exanthemata* and has been modified slightly in shape and to a greater degree in surface ornament. The dorsal and ventral rows of spines are present, but the midlateral row of spines is irregular. We do not know if the arrangement of the spines is consistent throughout a large population. Further study is required before this form can be properly identified and named. Sexual dimorphism was noted, with the subrectangular males more elongate than the shorter subquadrate females.

Dimensions. Length of adult male specimen 0.73 mm; height 0.39 mm. Length of adult female 0.59 mm; height 0.36 mm.

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APPENDIX

TABLE 2. *Location, depth, and salinity data of sample collection localities.*

Locality	Station*	Latitude (north)	Longitude (west)	Depth (feet)	Salinity (‰)
1	1H	24° 39.0′	81° 53.6′	27	37.27
2	6H	24° 59.0′	81° 24.8′	27	39.41
3	7H	25° 02.8′	81° 18.0′	27	39.92
4	10H	25° 23.8′	81° 22.0′	19	39.36
5	12H	25° 32.1′	81° 30.7′	24	.....
6	16H	25° 36.8′	81° 45.3′	31	37.97
7	20H	25° 30.3′	81° 57.7′	51	37.45
8	24H	25° 29.0′	82° 13.7′	82	37.39
9	30H	25° 59.7′	82° 26.3′	60	37.01
10	33H	26° 08.2′	82° 10.6′	54	37.10
11	36H	26° 13.3′	82° 01.3′	45	37.84
12	41H	26° 24.0′	81° 55.7′	20	37.41
13	44H	26° 24.0′	82° 05.7′	21	37.79
14	58H	26° 57.5′	82° 27.0′	28	37.21
15	59H	27° 00.7′	82° 28.2′	34	36.91
16	64H	27° 16.0′	82° 34.5′	24	37.24
17	66H	27° 12.5′	82° 40.5′	32	36.87
18	68H	27° 08.7′	82° 46.6′	63	36.90
19	70H	27° 01.5′	82° 58.8′	65	36.55
20	73H	27° 08.6′	83° 13.6′	95	36.33
21	76H	27° 24.8′	83° 26.4′	89	36.27
22	79H	27° 34.4′	83° 09.9′	60	36.89
23	81H	27° 39.2′	83° 01.5′	45	37.17
24	83H	27° 42.3′	82° 56.0′	34	37.37
25	84H	27° 43.8′	82° 53.7′	33	37.31
26	91H	28° 03.3′	83° 06.2′	43	36.97
27	95H	28° 23.2′	83° 24.8′	66	36.83
28	98H	28° 37.8′	83° 39.0′	60	36.92
29	104H	28° 56.6′	84° 02.9′	76	36.57
30	110H	28° 17.4′	84° 02.9′	92	36.82
31	116H	27° 37.7′	84° 02.9′	154	36.67
32	121H	27° 05.0′	84° 02.9′	239	36.36
33	127H	26° 54.4′	83° 20.8′	131	36.17
34	130H	26° 47.6′	83° 00.3′	89	36.28
35	8H	25° 03.2′	81° 17.9′	21	37.52
36	49H	26° 23.7′	81° 59.3′	20	36.23
37	51H	26° 20.6′	81° 59.3′	30	36.36
38	77H	27° 09.4′	82° 31.7′	29	35.61
39	7H	24° 40.0′	81° 55.3′	20	37.14
40	18H	26° 23.2′	82° 04.8′	22	34.86
41	31H	26° 40.0′	82° 41.0′	77	36.18
42	35H	27° 04.6′	82° 46.1′	68	36.00

*Stations at which oceanographic data were obtained by the University of Miami Marine Laboratory on each of three cruises. Localities 1-34, Cruise G-5616, August, 1956; Locs. 35-38, Cruise G-5624, December, 1956; Locs. 39-42, Cruise G-5703, March, 1957.